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The New Year Honours

THE New Year Honours List, which was published on Tuesday last, January 1st, announces the conferment of a Peerage upon the Right Honourable Sir John Anderson, G.C.B., F.R.S., who becomes a Viscount. The list also announces the conferment of Knighthoods upon Professor Leonard Bairstow, D.Sc., D.Eng., F.R.S., chairman of the Aeronautical Research Council; Mr. G. P. Barnett, H.M. Chief Inspector of Factories, Ministry of Labour; Mr. J. L. Blake, M.Sc., Comptroller-General, Patent Office; Mr. J. P. Bowen, M.I.C.E., lately Engineer-in-Chief, Corporation of Trinity House; Dr. D. R. Pye, C.B., M.I.Mech.E., F.R.S., lately Provost of University College, University of London; and Mr. Alexander Williamson, C.B.E., M.I.C.E., chairman and managing director of William Beardmore and Co., Ltd. In the Order of the Bath, the G.C.B. is conferred upon General Sir Brian Robertson, Bart., G.B.E., Colonel Commandant, Corps of Royal Engineers and Corps of Royal Electrical and Mechanical Engineers; the K.C.B. is conferred upon Vice-Admiral (E) the Honourable D. C. Maxwell, M.I.Mech.E., M.I.N.A.; and the C.B. upon Rear-Admiral (E) G. C. Ross, C.B.E., A.M.I.Mech.E., Major-General Collin Bullard, C.B.E., M.I.Mech.E., M.I.E.E., and Air Vice-Marshal Hugh Granville White, C.B.E., M.I.Mech.E. In the Most Excellent Order of the British Empire, Lieut.-General A. M. Cameron, C.B., M.C., late Corps of Royal Engineers, and Acting Air Marshal Colin W. Weedon, C.B., M.A., M.I.Mech.E., A.F.R.Ae.S., become K.B.E. in the Military Division, and Rear-Admiral (E) Frederick V. Stopford and Engineer Captain Harold Welch, R.N., become C.B.E. In the Civil Division, the following are created C.B.E.:—Mr. G. L. Bailey, M.Sc., Director of Research, British Non-Ferrous Metals Research Association; Mr. J. L. Bartlett, M.I.N.A., Deputy Director of Naval Construction, Admiralty; Mr. A. F. Bennett, M.I.E.E., director of Automatic Telephone and Electric Company, Ltd.; Mr. E. H. Browne, chief mining engineer, National Coal Board; Mr. H. H. Burton, director, English Steel Corporation, Ltd.; Mr. I. H. Cox, lately Director of Science, Festival of Britain; Mr. Ralph Freeman, M.I.C.E., lately consulting civil engineer, South Bank Exhibition; Mr. J. Ramsay Gebbie, M.I.N.A., managing director of William Doxford and Sons, Ltd.; Mr. F. St. Aubyn Hartley, Keeper of the Science Museum; Dr. Harold Hartley, chairman, Radiation Ltd.; Dr. T. P. Hilditch, F.R.I.C., F.R.S., lately Professor of Industrial Chemistry, Liverpool University; Captain R. R. Kippen, A.M.I.N.A., marine manager of Ellerman Lines, Ltd.; Mr. Willoughby Lappin, Rolls-Royce liaison officer with the Royal Air Force and Government departments; Dr. F. M. Lea, F.R.I.C., director of the Building Research Station; Mr. A. E. H. Masters, M.I.Mech.E., chief scientific officer, Fighting Vehicles Design Establishment, Ministry of Supply; Mr. R. F. Newman, director and general manager, Transport Equipment (Thornycroft), Ltd.; Mr. M. W. Perrin, lately deputy controller, Atomic Energy Division, Ministry of Supply; Dr. Denis Rebbeck, M.I.Mech.E., M.I.N.A., M.I.Mar.E.; Mr. H. L. Stevens, M.I.Mech.E., F.R.Ae.S., Principal Director of Equipment, Research and Development (Air), Ministry of Supply; Brigadier R. P. Wheeler, F.R.I.C.S., Deputy Director-General, Ordnance Survey Department; Mr. T. H. Windibank, M.I.E.E., director, Crompton-Parkinson, Ltd.; Dr. Arthur Winstanley, M.I.M.E., Deputy Chief Inspector of Mines, Ministry of Fuel and Power; and Mr. W. F. Wegener, lately chief mechanical engineer, Malayan Railway.

Aircraft Catapult

A CATAPULT, which has been developed by the Admiralty and is capable of launching the largest carrier-borne aircraft, is to be demonstrated in the United States. In the past fourteen months the prototype equipment has undergone successful trials in H.M.S. "Perseus," and the trials are to be continued, with the co-operation of the U.S. Navy, during which U.S. naval aircraft will be launched from the ship. The catapult operates on the slotted cylinder principle and the hook, to which the aircraft is attached, is connected to a piston driven by high-pressure steam, while a sealing device maintains the slotted cylinder steam-tight. A large quantity of steam is required, but trials have demonstrated that the main boilers can meet the demand without sacrifice of the ship's operational efficiency. It is estimated that the equipment for the catapult will occupy less space than the launching gear at present in service, and installation for operational use in existing ships would not call for any alteration in the level of the flight deck. The effectiveness of the gear was demonstrated when aircraft were launched successfully with the ship at anchor. The ability to do this will affect aircraft carrier design and also modify naval air tactics, since it will not be essential for carriers to steam out of line into the wind in order to fly off aircraft.

Uranium Search

THE Ministry of Supply has stated that a British expedition has left Freetown on a geological exploration of hitherto uncharted country of Sierra Leone and the Gold Coast. The leader of the party is Mr. Dennis Ostle, of the British Geological Survey, and he is accompanied by Mr. F. H. Hale, of the Atomic Energy Research Establishment, while officers of the Sierra Leone and Gold Coast Geological Surveys are collaborating. Using a new design of Geiger counter, mounted in Land Rover vehicles, the expedition has set out to discover whether the radio-active elements uranium and thorium, essential for atomic energy projects, exist in the territory. The detecting equipment, which consists of eight tubes, each about 2ft 6in long, will automatically record the presence of these elements in the subsoil and also indicate whether the quantities are significant, the presence of any strong deposit being indicated by a buzzer "alarm" signal. All rocks contain small quantities of uranium and thorium, the amount varying with the geological formation, so that the new instrument which is sensitive to small variations should prove of use in making geological maps.

European Steel Production

STEEL production in Europe reached a new high level last year, according to the fifth issue of the quarterly bulletin of steel statistics issued by the Economic Commission for Europe. This statement is based upon the returns available for the first ten months of 1951, from which it is estimated that the crude steel production of Europe, excluding the U.S.S.R., will be about 67·9 million tons, or 11·7 million tons above production in 1950. The only important steel producing country which shows a lower output rate of crude steel compared with 1950 is the United Kingdom. This drop in production is attributed to the reduced availability of imported iron and steel scrap, which for the first nine months of 1951 amounted to 414,000 tons, as compared with 1,699,000 tons for the same period of the previous year. It is considered that had scrap imports to the United Kingdom remained at the same level as in 1950 the crude steel production would have amounted to some 17¾ million tons, as compared with the estimated actual production of 15·9 million tons for 1951. Every European country with the exception of the United Kingdom, Germany and Spain will, it is stated, attain the highest recorded production of steel during 1951. Had it not been for shortages of coke, scrap and ore most of these countries could have obtained even better results. Other statistics given in the bulletin indicate that European pig iron production will reach 49·4 million tons in 1951, as compared with 43·4 million tons in 1950.

Retirement of Mr. H. C. Wood

AFTER an association of more than forty-two years with the Wellman Smith Owen Engineering Corporation, Ltd., and its predecessors, Mr. Harold Carrington Wood retired at the end of 1951. Mr. Wood studied engineering at the University College, London, and served his apprenticeship with the Airdrie Iron Company. When he entered the service of Wellman Seaver and Head, Ltd., in 1909, he was entrusted with the responsibility of establishing a subsidiary company in Dusseldorf and developing the company's business in steel works plant in Germany. He resided in Germany for five years up to the outbreak of war in 1914, and during that time was instrumental in promoting the installation of Wellman tilting furnaces and charging machines in a number of Continental countries. After serving in the Royal Naval Division Engineers in the 1914–18 war, he returned to the Wellman organisation, first as foreign sales manager and later in charge of home sales—a position which he held for many years. Mr. Wood is a member of the Institution of Mechanical Engineers and has presented a number of papers to the Iron and Steel Institute and the Coke Oven Managers' Association.

P. W. Willans Centenary Exhibition

To mark the centenary of the birth of Peter William Willans, who played such a prominent part in the early development of the high-speed steam engine, the Science Museum has arranged a special exhibition at South Kensington. This occasion was also marked by a lecture before the Newcomen Society on November 8th last by Mr. Kyrle W. Willans, the son of the inventor. P. W. Willans was born in Leeds on November 8, 1851, and in the course of his career designed and built notable new types of high-speed steam engines, which were used for driving electrical generators and for propelling steam launches. In 1880 he founded the firm of Willans and Robinson at Thames Ditton, and at these works he introduced what were then advanced methods of manufacturing interchangeable parts for different sizes of engines. This firm subsequently moved to Rugby and its works are now part of the English Electric Company's establishment. In addition to several historical photographs of Willans, his engines, launches, &c., three of his original high-speed vertical steam engines are being shown at the Science Museum. One of these engines was made in 1884 and worked for many years in the Royal Laundry at Kew, before it was presented to the Museum by King George V in 1929. The central valve triple-expansion engine exhibited is the unit used by Willans for the economy trials published by the Institution of Civil Engineers in 1888. As an outcome of this work Willans received the Watt Medal of the Institution and a Telford Premium. The third engine is a twin-tandem compound central valve unit, directly coupled to a Siemens dynamo, which was built by Willans in 1888. The exhibition will remain open until January 13th.

British Locomotives in 1951

THE past year was a particularly interesting one for locomotive enthusiasts because examples of the new standard locomotives began to serve on British Railways and technical details of their designs became available. According to the rolling stock programme announced by the Railway Executive for the year, 159 of the 400 locomotives to be built in 1951 were to be "standards." Particular interest was taken in the design of the new Class "7" "Pacific" 4–6–2 locomotives, both because they are the largest standard types and because details of their design became available before the others. One of the class underwent extensive tests at the Rugby testing station, and towards the end of the year numbers of the class were in service in the different regions in widely varying service. Despite the minor criticisms that are always to be expected when a new engineering project first enters service, these engines earned the good opinions of all who had anything to do with them. But unfortunately, late in the year, serious troubles began to be experienced and it was thought advisable to withdraw all locomotives of the class from service. It is the hope of everyone that the investigation of the trouble, since put in hand, will prove successful in tracing the root causes and that, once found, the defects will prove amenable to simple remedies.

The first of the Class "7" standard locomotives, No. 70,000 "Britannia," was described in our issues of February 2 and 9, 1951. The "Britannia" or Class "7" locomotive, illustrated on Plate 2, like the remainder of the standard engines, was designed under the direction of Mr. R. A. Riddles, member of the Railway Executive for mechanical and electrical engineering. This 4–6–2 engine is designed for mixed traffic working over routes covered by locomotives such as the "Castles," "West Country," L.M.R. Class "6," and ex-L.N.E.R. "V2." During the brief period it was in service it put up some good performances in several parts of the country. It is the first "Pacific" 4–6–2, two-cylinder engine to be placed in operation in this country and is the most powerful we have yet built for passenger service.

The leading particulars of No. 70,000 are as follows :—

Main Particulars of Locomotive No. 70,000

Cylinders (two)	20in by 28in
Coupled wheels	6ft 2in dia.
Wheelbase, rigid	14ft
Total weight in working order (engine)	94 tons
Boiler pressure	250 lb per sq in
Heating surface :	
Tubes : 40 large, 5¼in O.D. ... ... } 136 small, 2¼in O.D. ... ... }	2,264 sq ft
Firebox	210 sq ft
Total evaporative	2,474 sq ft
Superheater	718 sq ft
Total	3,192 sq ft
Grate area	42 sq ft
Tractive effort	32,150 lb
Adhesion factor	4·23
Minimum radius curve (with specified gauge widening)	4½ chains
Tender :	
Coal capacity	7 tons
Water capacity...	4,250 gallons
Weight empty	21 tons 4 cwt
Weight full...	47 tons 4 cwt

Fabrication is used extensively in the construction of the main frames, which are of 1½in thick steel plates spaced 3ft 2½in apart, and are well braced by vertical and horizontal stretchers and pin-jointed cross-stays attached to the horn plates. The front of the boiler barrel and the firebox front are supported by two vertical stretchers and a rear end extension to the main frame supports the back of the firebox on brackets.

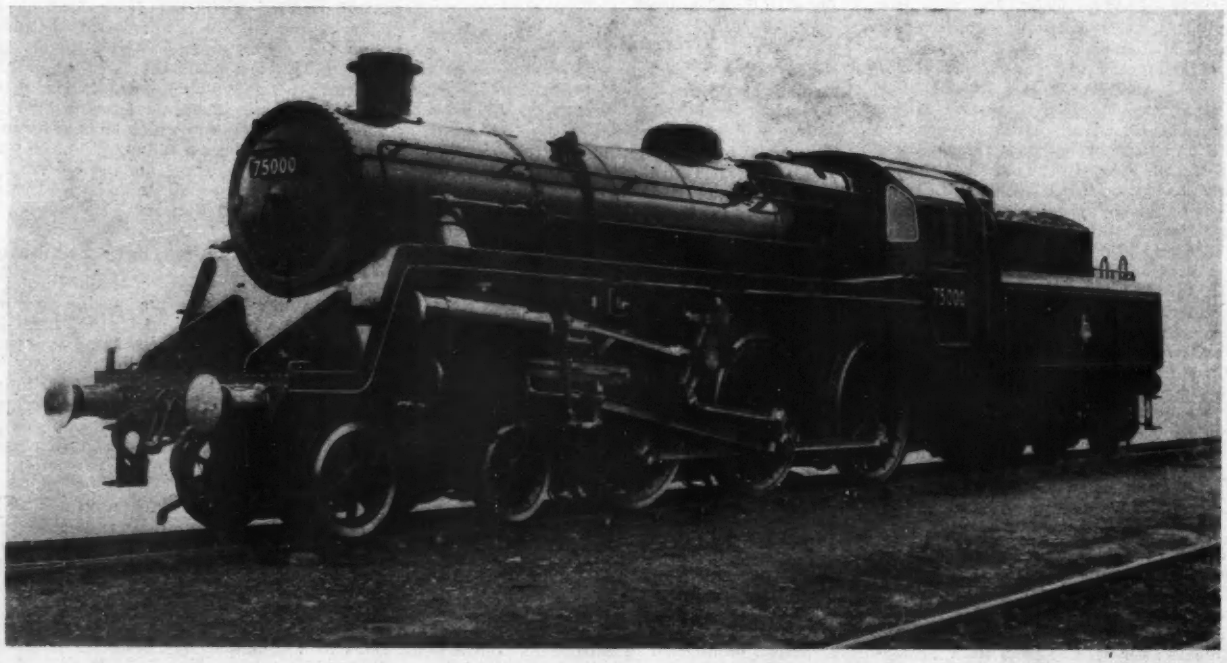
The design of the boiler follows general practice and it has a centrifugal drying unit in the steam dome to remove water from the steam before it enters the steam pipe. The superheater header in the smokebox incorporates a multi-valve regulator, to which access is given by a detachable cover in the top of the smokebox. Separate shut-off cocks to each steam supply are provided in a steam manifold mounted on top of the firebox in front of the cab, and a main steam valve is operated from inside the cab. As is now general practice on large main line engines, a rocking grate and self-emptying ashpan are fitted.

The two 20in by 28in cast steel cylinders of the locomotive are fitted with cast iron liners in the barrel and the valve chest. Piston valves 11in diameter are operated by conventional Walschaerts gear with a full gear cut-off of 78 per cent. Both the engine and the tender are carried on Timken self-aligning roller bearing axleboxes, some particulars of which were given in THE ENGINEER of November 16th last. Coupled wheels 6ft 2in diameter have built-up weights, which balance the revolving weights and 40 per cent of the reciprocating weights.

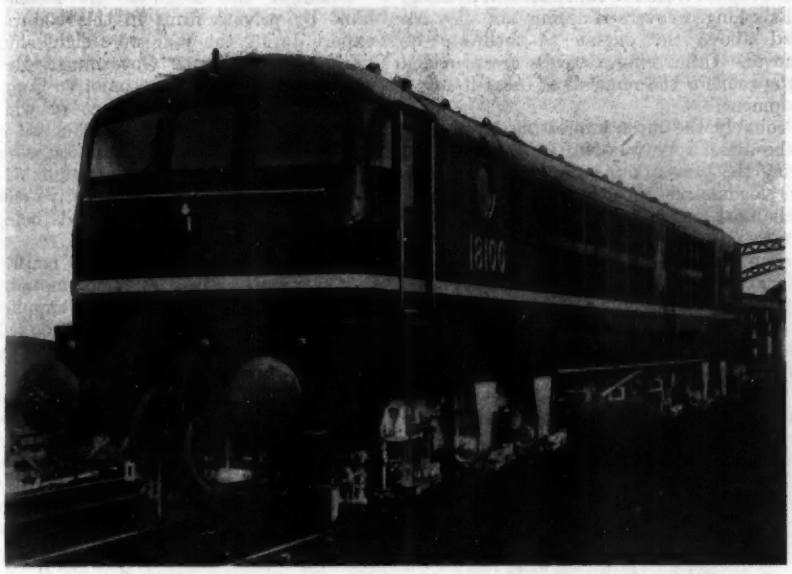
A four-wheeled bogie carries the engine weight on side bolsters and laminated springs fitted in compensating beams; side play control is effected by double coil springs. On the pony track frame the engine weight is taken at the pivot point and on bolsters sliding on pads on the frame at each side behind the centre line of the axle.

The structure of the cab is carried by cantilever supports attached to the firebox back plate and by a diaphragm plate at the dragbox. By this arrangement the cab has freedom to move with the boiler as expansion takes place. To avoid the effects of differential expansion all of the boiler fittings and pipes are kept free from the main frames, and the exhaust injector and the live steam injector are carried on brackets from the ashpan and foundation ring. The steam and water controls for both injectors are operated by the fireman, and all of the driver's controls are grouped for easy access and operation.

Many of the features of design and details of the standard 4–6–0 Class "5" mixed traffic locomotives, which were put into service later in the year, are common to the Class "7" engines. These engines are intended for the duties carried out by L.M.R. Class "5," E. and N.E.R. "B1" and W.R. "Hall"



STANDARD 4-6-0 MIXED TRAFFIC LOCOMOTIVE



3000 H.P. BRITISH BUILT GAS TURBINE LOCOMOTIVE

classes and their leading particulars are :–

Class "5" Mixed Traffic Locomotives

Cylinders (two), dia. and stroke ...	19in by 28in stroke
Wheels, coupled, dia.	6ft 2in
Wheels, front bogie, dia.	3ft 0in
Wheelbase, coupled	15ft 6in
Wheelbase, engine	27ft 3in
Heating surface :	
Tubes	1,479 sq ft
Firebox	171 sq ft
Total evaporative	1,650 sq ft
Superheater	369 sq ft
Grate area	28·65 sq ft
Boiler pressure	225 lb per sq in
Tractive effort	26,120 lb
Adhesion factor	4·97
Weight of engine in working order	76 tons 0 cwt
Weight of tender in working order	47 tons 4 cwt

The first of these new engines, No. 73,000, is illustrated on Plate 2, and was described in THE ENGINEER of May 4th last. It has main frames of 1¼in thick plates, spaced 4ft 1½in apart, and well braced by horizontal and vertical stretchers and by pin-jointed cross stays attached to the axlebox guides. As with the Class "7" engines, Timken roller-bearing axleboxes are fitted throughout. The two cast iron outside cylinders have 11in diameter piston valves actuated by conventional Walschaerts gear. The cab arrangement is similar to that developed for all standard locomotives and the same kind of tender is used as on the Class "7."

The Class "4" standard mixed traffic locomotive illustrated on page 2 is similar in many respects to the new Class "5" engines, except that it is much lighter and is designed for almost universal use on main and secondary lines all over the country. It has two cylinders, 18in by 28in with 10in diameter piston valves driven through Walschaerts gear giving a full travel of $7^{11}/_{32}$in. Its boiler is very similar in construction to those fitted on L.M.R. Class "4" locomotives, except that it is 9in longer and has a working pressure of 225 lb against 200 lb per square inch. The total evaporative heating surface is 1444 square feet with a 265 square foot superheater surface. In working order the locomotive weighs 67 tons 18 cwt, and it has a tractive effort of 25,100 lb.

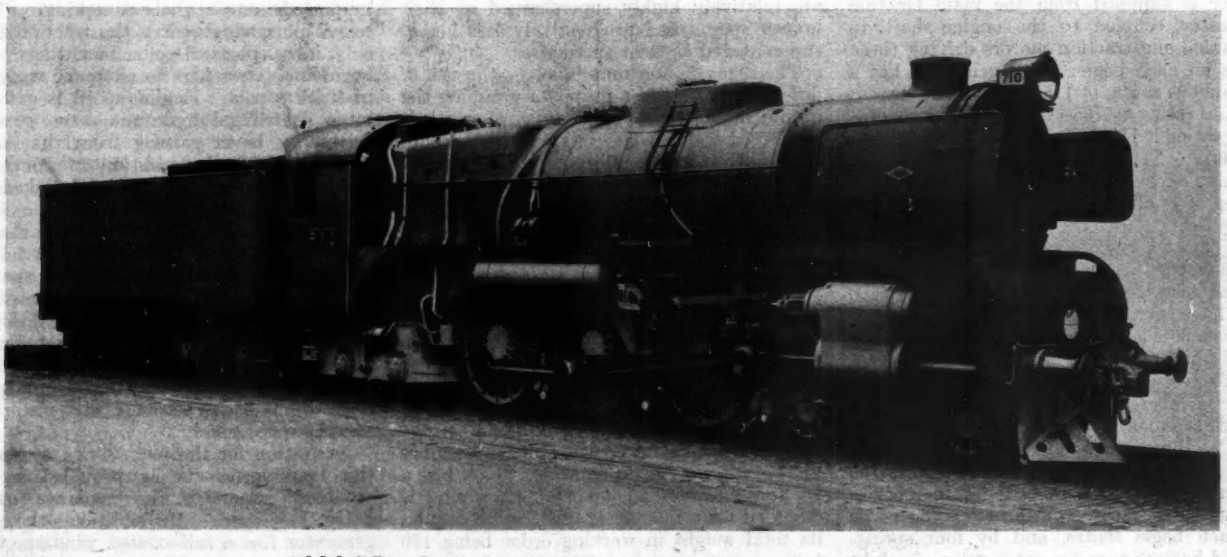
Fifty-four standard Class "4" tank engines were built under the year's programme, forty-four at Brighton and the remainder at Derby. This type of locomotive is of similar size and has the same operating capabilities, from the point of view of power output, as the Class "4" tender locomotive and many details are interchangeable between the two classes and with other standard locomotives. These 2–6–4 tank locomotives, one of which is illustrated on Plate 2, are intended for short distance suburban and cross-country working and short distance freight train haulage.

Towards the end of the year what has been one of the longest and most thorough trials on a locomotive ever carried out in this country concluded when it was announced that the former L.M.S. steam turbine locomotive No. 6202 was to be reconstructed as a four-cylinder engine of the "Princess Royal" class. During its working life this locomotive ran some 400,000 miles on main line service, and its conversion indicates that it has not proved up to expectations and compares unfavourably with four-cylinder reciprocating engines of similar capacity. Details of this interesting experimental locomotive were given in THE ENGINEER of July 5, 1935. Whilst we are discussing turbine locomotives, it is of interest to note that the gas turbine locomotive is still in service on the Western Region, and some particulars on its performances were given by Mr. O. S. Nock in our issue of July 13th last. One of the photographs we reproduce on this page shows the recently completed gas turbine locomotive No. 18100 which has been built for the Western Region by the Metropolitan-Vickers Electrical Co., Ltd. Some notes on this 30,000 h.p. locomotive, the first of its kind constructed in this country, were given in our issue of January 7th, 1949.

Amongst the steam locomotives under construction at the works of the private manufacturing companies during the year were seventy 4–6–4 engines for the Victorian Railways at the works of the North British Locomotive Company, Ltd. One of these locomotives, which are known as the "R" class, is illustrated on this page. It is of interest to note that, although the new engines are being built for the 5ft 3in gauge, provision has been made in their design for their conversion to a 4ft 8½in gauge. When such conversion is undertaken the main frames will remain unchanged, and the work will be simplified by the removal of distance pieces provided at the cylinder seatings to the frames, between the central connections of the cylinders, slide bar bracket and the trunnion and reversing shaft brackets.

The leading particulars of these locomotives are given in the table overleaf.

The locomotives have bar main frames cut from rolled slab and finished to a thickness of 5in. At the front end the frame has a



4-6-4 "R" CLASS LOCOMOTIVE FOR THE VICTORIAN RAILWAYS

cast steel headstock incorporating the buffer beam and dragbox, and the hind end of the frame consists of a one-piece cradle steel casting securely attached to the frames at the rear of the coupled wheels. Ample staying is provided in the frames by cast steel cross stretchers.

"R" Class Locomotive Particulars

Cylinders, diameter	21½in
Cylinders, stroke	28in
Wheels, coupled, diameter	6ft 0⅜in
Wheels, leading bogie, diameter	2ft 9in
Wheels, trailing bogie, diameter	3ft 1⅛in
Wheels, tender bogie, diameter	3ft 2½in
Wheelbase, coupled	12ft 10in
Wheelbase, engine	36ft 3in
Wheelbase, engine and tender	67ft
Heating surfaces:	
Tubes	1958 sq ft
Firebox, including siphons	285 sq ft
Total evaporative	2243 sq ft
Superheater	462 sq ft
Total	2705 sq ft
Grate area	42 sq ft
Boiler pressure	210 lb per sq in
Weight of engine in working order	107 tons 12 cwt
Weight of tender in working order	79 tons 16 cwt
Weight of engine and tender in working order	187 tons 8 cwt
Adhesive weight	58 tons 10 cwt
Adhesive factor at 85 per cent boiler pressure	4·04
Tractive effort at 85 per cent boiler pressure and 72in diameter wheel	32,080 lb

The cast steel cylinders, which incorporate the smokebox saddle base, are fitted with renewable cast iron liners in the steam chest and cylinder barrels, and the cylinder and steam chest covers are also of cast iron. Each cylinder is provided with three release cocks, one for each end of the cylinder and one for the steam chest. These cocks are connected together by rods and actuated through an air cylinder and spring by a control valve situated in the cab. By-pass valves are also fitted at the bottom of each cylinder.

The locomotives have Walschaerts valve gear which actuates 11in diameter piston valves having a maximum travel of 6½in and a cut-off at 75 per cent in full forward gear.

Skefko roller-bearing axleboxes are fitted throughout the locomotive and the coupled wheels have "SCOA-P" cast steel wheel centres, the revolving masses only being balanced by lead in the wheel pockets. Fuller details and a weight diagram of the locomotive are to be found in our issue of August 24th last.

Diesel and Diesel Electric Locomotives

The first of the three main line diesel-electric locomotives, No. 10,201, which was built by the Southern Region, and placed in service early in the year, is illustrated on Plate 3. It is powered by an English Electric 1600 b.h.p., "16 S.V.T." engine with a one-hour rating of 1750 b.h.p. Power is supplied from the main traction generator, coupled to the engine shaft, to six axle-hung traction motors driving three axles on each bogie. This generator has a continuous rating of 1155kW and the current at this rating is 1650A at 700V. The one-hour rating is 1155kW with a current of 1750A at 660V. The locomotive has a maximum tractive effort of 31,200 lb and a continuous rating of 14,000 lb, its weight in full working order being 135 tons.

A can be seen from the photograph we reproduced, this locomotive is very similar to the units which were built by the L.M.R. and have been in service since early in 1948. It has a 60ft long fabricated steel underframe built up from two main I-section inner members and two lighter channel section outer members. Cross members of plate and rolled sections carry the principal loads, such as the engine, generator, bogie centres, water tanks, boiler, &c. The load from the underframe is transmitted to the bogies through four large segmental bearings, two at each bogie centre, and by four spring-loaded bearers near the outer axles. A sheet steel body is riveted to rolled section framing, and six hinged covers of aluminium alloy are fitted above the engine to facilitate its removal. Other hinged covers are provided in the roof for the removal of other items of equipment.

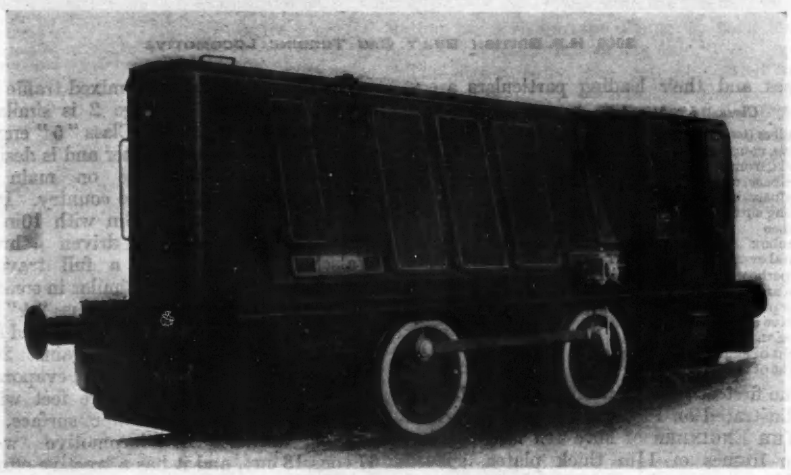
Probably the most interesting locomotive of the diesel type was No. 10,100, described during the year in our issue of June 1st last. This locomotive incorporates a system of mechanical transmission, and its design has been based upon an entirely new principle in diesel power application proposed by Lieut.-Col. Fell and jointly developed by Mr. H. G. Ivatt, of the L.M.R. and Fell Developments, Ltd. It now forms one of the many diesel units which are undergoing extensive trials on British Railways. The locomotive—see Plate 3—has eight-coupled wheels and a four-wheeled bogie at each end, and all the controls are duplicated in a driving cab at each end.

The transmission system is designed to facilitate the grouping together of the power outputs of four engines, each of 500 h.p. and having the required torque characteristics. As the transmission employed is purely mechanical without the use of either electrical or hydraulic torque conversion, it is essential that the main propelling engines should be capable of developing very high torques at low rotational speeds in order to start trains moving and to haul them up steep gradients. For this reason the engines are relatively highly supercharged at their lowest speeds and progressively less highly supercharged as their speed rises.

The transmission unit involves the use of differential gears as a means of grouping the output of the four engines, each of which is connected and disconnected through a scoop-controlled, variable filling, hydraulic coupling. The maximum tractive effort is developed when only one engine is driving the train, and by bringing successive engines into action the speed of the train is increased. The changes in speed ratios are made by operation of finger triggers in the driver's cab; this fills the hydraulic couplings in turn and is done with the regulator held in the maximum power position until all four engines are on load and running at the same speed. Once this condition has been reached the regulator is manipulated as required to give the desired train speed with all four engines in operation. The locomotive, which has a tractive effort of 25,000 lb at 12 m.p.h., is designed for a maximum speed of 78 m.p.h., its total weight in working order being 120 tons.

Amongst the diesel-electric locomotives built by private firms in this country for export during the year were eight shunting units for the Ceylon Government Railway by the North British Locomotive Company, Ltd. These locomotives, one of which is shown on Plate 3, are for 5ft 6in rail gauge and are designed for both shunting work and freight train haulage. Each weighs 54 tons in working order and has a tractive effort of 35,000 lb, the maximum speed being 20 m.p.h.

The electrical equipment, main and auxiliary generators, traction motors and control gear were designed and supplied by the General Electric Company, Ltd. Each locomotive is powered by a Davey Paxman twelve-cylinder, 625 b.h.p. at 1250 r.p.m. diesel engine, which drives the generator through a flexible coupling. In each of the two four-wheeled bogies a nose-suspended traction motor drives each axle through double-reduction gearing. The drive from each of the four motors is housed in a single gearcase, the intermediate shaft running in bearings in the gearcase itself.



230 B.H.P. Diesel-Electric Steelworks Locomotive

The main and bogie frames are welded structures of steel sections and plates, as light as possible consistent with strength. Side bearers with rubbing faces of manganese steel, each backed by a damping pad of rubber, are mounted on the bogie frames to carry the weight of the body. The spherical seat of each bearer sleeve is supported on a helical spring. Bogie centre pins, which carry the traction forces only, have spherical collar mountings in the bogie cross stretchers to allow for variations in track aspect. Engine speed is governed by a centrifugal hydraulic servo governor driven by bevel gearing from the end of the camshaft. In addition to controlling the fuel supply, the governor is linked to a valve which can admit oil to the servo-motor of the automatic load-control rheostat if the engine speed varies from that selected by the speeder bar. The engine speed is set by pneumatic pistons, operated by electro-pneumatic valves energised through the master controller, which act on the speeder bar. Eight speeds are obtained with only three pistons by means of a special form of linkage between the piston-rods and the speeder bar.

Excitation for the main series winding of the main generator is provided by the auxiliary generator, no separate exciter being employed. In addition, the main generator has a self-excited winding, which assists the separately excited field; a

series winding arranged to give a drooping characteristic to the generator output and to limit the maximum current; and a starting winding to enable the generator to be motored for starting the diesel engine.

The North British Locomotive Company, Ltd., announced in June last that it is now building the 100 b.h.p. "North British Miner" mines locomotive fitted with a hydraulic transmission unit designed on the Voith system. With this form of transmission only three running controls are used—throttle, reverse lever and brake. The transmission consists basically of two fluid circuits—a torque converter, for starting and low speed, and a fluid coupling for the upper speed range. When driving one of the locomotives movement of the throttle lever away from the idling position opens a filling valve in the delivery line from a centrifugal pump in the sump of the transmission casing, and the locomotive immediately gathers way. The drive is taken through the torque converter until the speed has reached about 6 m.p.h. At this stage a mechanical governor driven by the output shaft in the transmission comes into operation and the oil is directed from the pump to the fluid coupling, the torque converter emptying while the coupling is being filled. The change-over is quite automatic and requires no attention from the driver. On reaching greater resistance at the rail when entering a grade, the reverse process of changing down to the torque converter is equally automatic and simple. Changing of gears by the driver is eliminated and there is no wear and tear on clutches and gears.

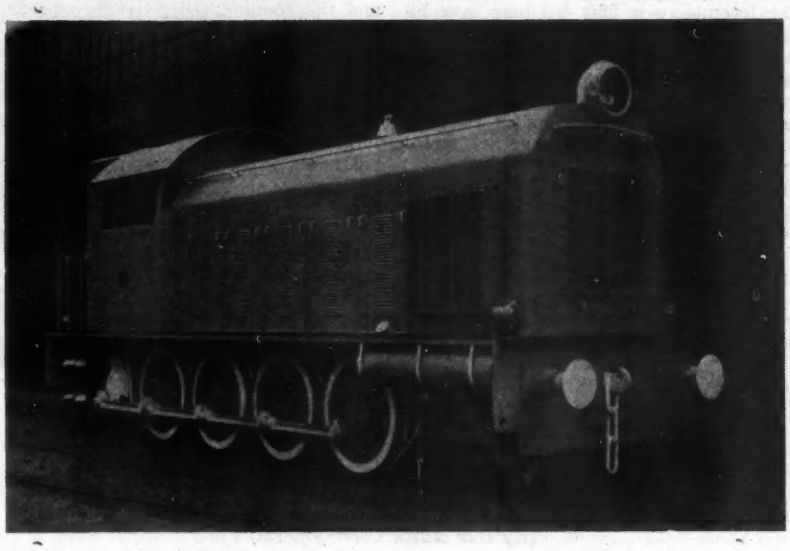
The company also recently completed the first of a series of shunting locomotives fitted with North British-Voith hydraulic transmission of the above kind. This locomotive, is a 200 h.p., 0–4–0 unit weighing 32 tons, and it is designed for general yard and railway duties. It has a tractive effort of 21,500 lb, and is designed for a maximum speed of 12 m.p.h. With its short wheelbase of only 6ft, it is suitable for all kinds of medium shunting work, and we understand that other locomotives of 300 h.p., 500 h.p. and 600 h.p. are being built for shunting and main line duties.

One of two 230 h.p. diesel-electric locomotives built for service in a steelworks by the Yorkshire Engine Company, Ltd., is also illustrated on page 4. These engines, which weigh 44 tons and have a starting tractive effort of 24,000 lb, are specially designed for the high starting tractive effort and good low-speed performance required in heavy industrial application. They are of rigid frame construction, with heavy castings incorporated to give added streng h for the very heavy duties encountered in service and to increase the adhesive weight. At front and rear heavy cast buffer beams on spring-loaded shock absorbing gear are fitted in addition to standard buffer gear.

The power unit is a six-cylinder Davey Paxman oil engine developing 230 b.h.p. at 1250 r.p.m., and it drives a B.T.H. three-winding, self ventilated d.c. generator. Each of the two axles is driven by a B.T.H. reversible, series-wound, self-ventilated, traction motor through double reduction gearing. With the gear ratio fitted the locomotive has permissible speeds up to 25 m.p.h., and provision is made for disengaging the gears should it be required to tow the locomotive at higher speeds.

Some interesting trials on a difficult length of line in the Leeds area were carried out during September with one of four standard gauge 0–8–0 diesel mechanical locomotives built by the Hunslet Engine Company, Ltd. One of these engines is intended for this country and three for service in Peru on the Paita/Piura Railway. The first of the new engines, illustrated below, was described in THE ENGINEER of September 21st and brief notes were given of its tests.

The locomotive has 48in diameter wheels spread over a wheelbase of 13ft 6in, and in full working order its weight is 55 tons, the maximum axle load being 14¼ tons. Its wheelbase and axle load were arranged to suit the conditions on the Paita-Piura Railway and the top speed of 33 m.p.h. was also chosen to suit the operating conditions on that line.

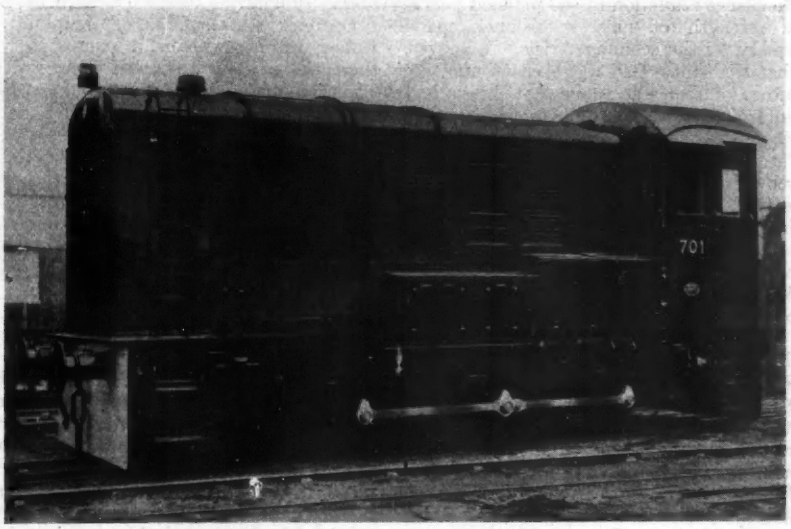


500 B.H.P. DIESEL MECHANICAL LOCOMOTIVE

The 1¼in thick steel plate frame structure is tied at each end by heavy buffer beams and horizontal and vertical stretchers, one of which comprises the lower half of the welded steel gearbox, forming a rigid cross member some 7ft long. The power unit is a twelve-cylinder Paxman oil engine, developing 500 b.h.p. at 1375 r.p.m. It drives a six-speed gearbox through a fluid coupling, flexible coupling, cardan shaft and a self-ventilated clutch. This gearbox incorporates a pre-selective mechanism and reverse gear, and final drive to the wheels is taken through a jackshaft.

Following the makers general practice, gear changes are made with internal gear clutches operated by air pressure. The reverse gear, which is between the change gear and the jackshaft, is also air operated. The whole of the control gear is mounted in the top of the box, the box and control forming the complete unit. Even the main clutch, which is normally carried on the engine, is mounted on the input shaft outside the gearbox, so that the complete transmission, including the whole of the control mechanism, forms one complete sub-assembly.

After having built steam locomotives for some seventy-five years, the well-known firm of W. G. Bagnall, Ltd., built its first diesel-electric shunting locomotive in 1951 in association with the Brush Electrical Engineering Company, Ltd., and Mirrlees, Bickerton and Day, Ltd. These three firms have now associated themselves under the name of a new company, Brush Bagnall Traction, Ltd., for the construction of diesel-electric locomotives. The new locomotive, one of four similar units being constructed for service in a steelworks, is illustrated below. It is an 0–6–0 unit designed for a maximum tractive effort of 32,000 lb, a tractive effort at one-hour rating of 18,600 lb and a continuous tractive effort of 15,100 lb,



480 B.H.P. STEELWORKS LOCOMOTIVE

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the speeds being 7·2 m.p.h. at the one-hour and 8·3 m.p.h. at the continuous ratings.

The six-cylinder, four-stroke, Mirrlees engine is fitted with a Buchi exhaust gas turbo-charger, and is rated at 480 b.h.p. for twelve hours at 720 r.p.m. and 528 b.h.p. for one hour at 720 r.p.m. Directly coupled to the engine is the main generator which has a continuous rating of 280kW, 519V, 540A at 720 r.p.m. Nose-suspended traction motors drive the two outer axles of the locomotive through double reduction gearing.

The locomotive is 26ft 4in long over its buffer beams and its full weight of 55 tons is available for adhesion through the 48in diameter coupled wheels. In the large driver's cab the controls are duplicated on each side and full protection is afforded against the heat radiating from hot metal when hauling ladle cars.

These engines have been built for the Steel Company of Wales, Ltd., and it is interesting to note that W. G. Bagnall, Ltd., has also built for the same company three steam shunting locomotives incorporating the latest developments in steam practice. One of these 0–6–0 saddle tank locomotives was described in THE ENGINEER of April 20, 1951. It incorporates details which, although unusual in industrial locomotives, are designed to facilitate maintenance and servicing and make the locomotive easy to handle. The engines have 18in by 26in cylinders and a boiler pressure of 180 lb per square inch, their weight in full working order being 52·5 tons and the tractive effort at 85 per cent boiler pressure 25,272 lb. It was stipulated by the users that the engines should be able to haul up to seven 65-ton ladle cars up an incline of 1 in 100 and traverse curves of 170ft radius.

Each locomotive is fitted throughout with Skefko roller bearing axleboxes and the coupling-rods, connecting-rods and eccentric big ends are also fitted with self-aligning roller bearings. Walschaerts valve gear is fitted and the weight of part of the valve rods, lifting links and die blocks is balanced by counterweights integrally forged on to the reversing arms. This balancing is designed to reduce the effort required on the reversing lever and to make the driver's job easier.

The use of two kinds of motive power, both of up-to-date design, in the same industrial establishment, should provide some interesting figures of comparative working costs and efficiencies. In view of the controversy which has long existed it is hoped that these figures will be made available after a reasonable period of service by the Steel Company of Wales.

The Royal Navy, 1951

(By Our Naval Correspondent)

No. I

THE YEARS SINCE THE WAR

IT has not been easy for the British people to understand what has been happening to their Navy during the past six years. After a successful war for survival and with the elimination of potential enemy surface fleets there was a natural and universal desire to get back to our lawful occasions. The wholesale scrapping, selling and giving away of British warships of every kind, from battleships to motor launches, was regarded as the outcome of a successful war and the need to get back to a peacetime standard. There was, it is true, some uneasiness throughout the country in the autumn of 1947, when, after a heated exchange with Mr. Churchill and other Conservative leaders, the then Minister of Defence admitted that the effective strength of the Home Fleet had been reduced to one cruiser and four destroyers. But this was stated to be a temporary measure due to the further large reduction in the planned peacetime strength of naval personnel, made necessary by the economic crisis. Moreover, at that time there had not been an abortive Moscow Conference to prove that Russia had no intention of co-operating to preserve the peace of the world.

Throughout 1948 and 1949, after the Moscow Conference, Mr. Churchill and naval experts, both in and out of Parliament, did their utmost to arouse the country to the increasing menace of the Russian submarines, whose numbers were estimated by high-ranking serving United States naval officers to be between 280 and 300. They emphasised the great difficulty this country had in dealing with the thirty ocean-going submarines available to the Germans in 1939 and that as our 19/20-knot wartime frigates were now of little value, owing to the greatly increased submerged speed of the modern submarine, it was imperative to commence forthwith a building programme of fast anti-submarine vessels and medium-sized aircraft carriers. It is, unfortunately, no longer possible, now that the balance of sea power has been greatly affected by the submarine, the aeroplane and the atom bomb, for the layman to judge for himself the relative strengths of the navies of the world by counting the number of warships each has built or building. He is obliged to depend mainly on the statements and explanations given by Government spokesmen, and his natural desire to improve his standard of living and social services made him a willing and ready listener to the counter arguments put forward by those in authority. Viscount Hall, the then First Lord of the Admiralty, expressed his confidence that we could deal with any threat from submarines which might develop at the present time and emphasised that the great majority of the Russian submarines were of pre-war design. Viscount Alexander, a former First Lord and Minister of Defence, also assured the House of Lords that we were now in a much better position to deal with enemy submarines than we were in 1939.

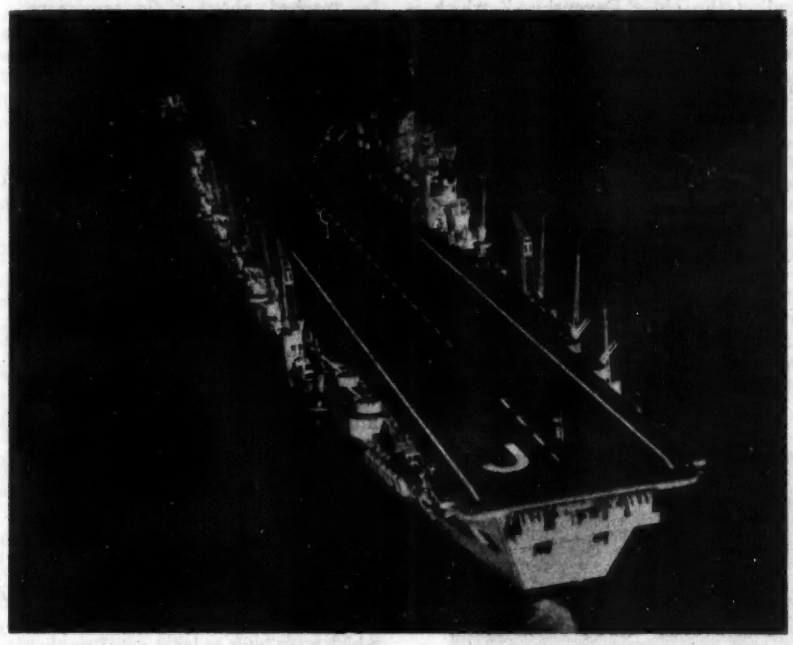
Optimistic statements of this kind continued until the Korean campaign, when there was at once a marked change of tone. The then Minister of Defence spoke of Russia "having a very large number of submarines, many of which are of modern design"; the then Parliamentary Secretary to the Admiralty referred to the grave threat presented by the Russian submarines; and, more recently, it was announced in a White Paper that we could not hope to win another battle of the Atlantic without the help of the United States Navy.

Finally, when Mr. Attlee announced a year ago his Government's intention to spend £4700 million on rearmament over the next three years—the scale to be limited only by the need to maintain our peacetime economy—it became clear that the whole country was thoroughly alarmed and had at last realised that a higher standard of living must give place to safety. A substantial and satisfactory naval building programme—no doubt the maximum practicable in the circumstances—was put in hand. It provides for the building of twenty-four fast anti-submarine frigates, forty-two modern mine-sweeping vessels, a large number of small craft, the conversion to anti-submarine escort vessels of forty-five of our existing 110 destroyers and the early completion of our six fast aircraft carriers—two fleet and four light fleet carriers—whose construction had been proceeding at a painfully slow rate since the war. The "Eagle," which accommodates about 100 aircraft, is now carrying out extensive sea trials preparatory to joining the fleet; the remaining vessels are to be completed by 1955. Though substantial, the programme has been started very late and provides only a fraction of the large number of modern anti-submarine vessels which will be required. It will, however, necessitate the earmarking for naval work of about 30 per cent of the labour force engaged in the shipbuilding and repairing industry, though much more could still be done if fewer ships were constructed in British yards for South American and other foreign countries. Some two-fifths of the output of British shipyards is at present for foreign account, and if smaller dollar earnings mean a smaller army, this might well be the lesser of two evils. It has never been British policy to build up and maintain in peacetime a large army for service on the Continent and we cannot continue to do so except at the sacrifice of sea power, with all that it entails—dependence on the United States Navy for the protection of our imports and the decline of our prestige and influence abroad in time of peace.

PRESENT STRENGTH OF THE FLEET

Apart from the "Eagle" (illustrated on Plate 4 and on page 7), a fleet carrier of 36,800 tons laid down during the war, no new fighting ships have been added to the fleet during the past year. One battleship—the "Vanguard"—has been kept in commission in the training squadron and is to become flagship of the Home Fleet in the spring of this year; the remaining four of our existing battleships are laid up in "mothball reserve" in the Clyde, the "Duke of York" having joined her sister ships there last September. The "mothball" process was developed at the end of the war by both the British and United States navies. All the working parts of gun mountings and machinery are enclosed by airtight plastic covers sprayed on and are then "dehumidified" so that they cannot rust, and remain in good working condition. So prepared, the ships need only a few caretakers to look after them, with a consequent large saving in manpower, and can be brought forward for service when required almost as soon as crews can be organised to man them. At the outbreak of the Korean campaign the Americans were able very quickly to add a battleship, several carriers and many smaller craft to their active fleet by taking them from the "mothball reserve."

In spite of reports from Finland, Sweden and other foreign countries that the Russians have from one to three new battleships built or building, there is no sound evidence that any of these ships will be available in the near future and our own battleships are unlikely to be required immediately on the outbreak of a war. None the less, United States battleships, with their powerful and concentrated anti-aircraft armament, gave invaluable support to the carriers in the Pacific when carrying out offensive operations in the Japanese war, and battleships may well be required to operate with task forces in the future. It is thus regrettable that we are unable to maintain one battleship in commission in each of our two main fleets to give training to the personnel both in handling



FLEET CARRIER H.M.S. "EAGLE"

this kind of ship and in operating other ships in company with her. The United States will soon have three battleships in commission for this purpose.

AIRCRAFT CARRIERS

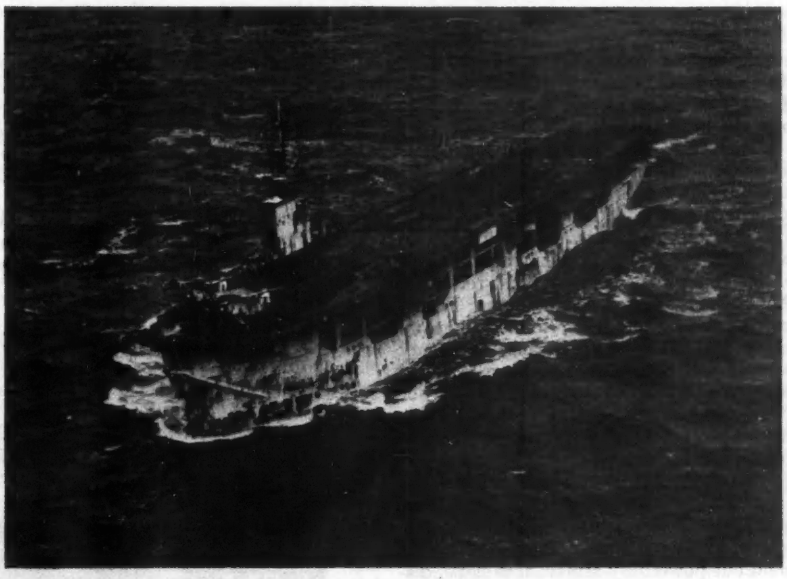
With the present rapid development of guided missiles and the reduction in the size and weight of the detonating mechanism of atomic explosive, we may anticipate revolutionary changes in the main armaments of large ships within the next few years. Meanwhile the striking power of a Navy to-day is largely vested in aircraft and, in consequence, the carrier is given the leading position in the fleet. This is well illustrated by the present composition of our squadrons, for there are now three fleet aircraft carriers in commission—one in the Home Fleet and two in the training squadron. Apart, moreover, from the added importance of the carrier to-day, her function in naval warfare has changed considerably as the result of the elimination of potential enemy battleships. She was designed to provide aircraft for locating the enemy battle fleet and reducing its speed by torpedo bomber attack. In doing so her aircraft had to overcome the opposition of hostile aircraft, which were restricted by the same conditions, both having to operate from a carrier. It was thus a comparatively simple problem for our naval constructors and engineers to design vessels which in performance and other operational requirements were at least as good as, if not superior to, those of a potential enemy. But under present-day conditions, while the smaller carriers will be earmarked for general reconnaissance and anti-submarine work, the large fleet carrier will be required for task forces for offensive operations in enemy waters; and this will entail opposition from shore-based fighters. It is thus essential that they should be able to operate up to date naval fighters in addition to fast and powerful medium range bombers.

Apart from the carriers transferred to the Dominion and Western European navies, Great Britain's post-war fleet now includes only seven fleet carriers and six light fleet carriers, the latter having a designed tonnage of some 13,000 tons with a speed of 24 knots—too small and too slow to operate the latest types of aircraft. These six vessels of the "Glory" class were, in fact, laid down in 1942, at a time when the urgent need for both repair and new construction imposed rigid economy in naval building, and were regarded as makeshift vessels intended to meet the immediate requirements of the Japanese war. Some of them have been used and have done excellent service in the Korean campaign, but they are already stretched to the limit in having to operate piston engine aircraft of a weight half as heavy again as those of six years ago and with take-off and landing speeds some 30 knots in excess of their predecessors of that time. They are thus no longer of much value for task force operations overseas when their aircraft would be required to operate against land-based jet aircraft.

By 1955 the "Ark Royal"—sister ship of the "Eagle"—and the four 30-knot light fleet carriers of the "Hermes" class will have joined the fleet, making a total of twelve carriers with the necessary speed and performance to operate aircraft capable of dealing with modern land-based aircraft; and the availability of even this small number will depend on the modernisation of the six existing fleet carriers of the "Illustrious" class. These ships are now being taken in hand one at a time for modernisation, which includes strengthening the flight deck and lifts and the installation of higher performance arrester gear and catapults. A further extensive modification may also be required in the near future if developments in the rubber flight deck prove satisfactory. For a rubber flight deck will not only enable a carrier to operate higher performance aircraft—as a result of the replacement of the undercarriage by skids—but also do away with the need for high speed which is at present still required for "landing-on" aircraft.

THE CONVOY ESCORT CARRIER

In world war II some forty-five convoy escort carriers, of about 9000 tons displacement, with a speed of 16 knots and constructed on merchant ship hulls, were obtained from the United States. They accompanied convoys throughout their voyages, one carrier for each convoy, and did noble work in keeping U-boats submerged and preventing them shadowing a convoy on the surface and attacking in packs after dark, using radar to aim. But concurrently with the increase in the submarine's offensive power as a result of the snort and greatly increased submerged speed, aids to aircraft in anti-submarine warfare have made rapid strides. The weight and size of both detecting devices and anti-submarine weapons now being installed in aircraft have increased to such an extent since the war that the modern anti-submarine aircraft will not be able to operate from escort carriers of the small dimensions and limited speed of those used in the last war. The escort carrier of the future will require to be a ship of approximately the size, speed and performance of the "Glory" class, and it will not be easy to find merchant ships of this kind for conversion in view of the demands for shipping in war. The problem will be much simplified, however, if the flexible rubber flight deck proves satisfactory, for the undercarriage—which could then be dispensed with—takes up a percentage of the total weight of an aircraft out of all proportion to its value. There are none



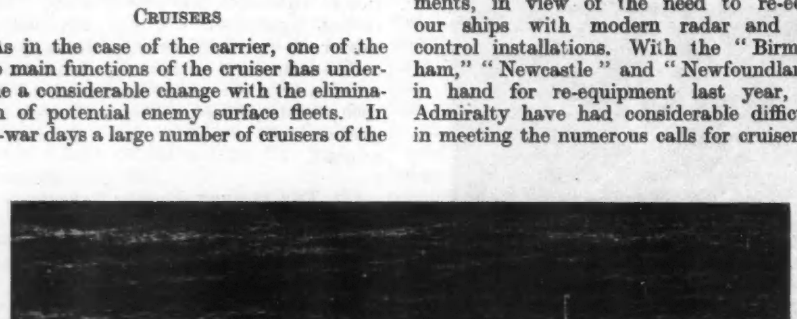
M.S. "ANCYLLUS"—AN ESCORT CARRIER OF THE 1939-45 WAR

of the original escort carriers, apart from the old "Campania," now remaining in the Royal Navy, but the six "Glory" class may be regarded as the nucleus of the carriers required for anti-submarine duties in the future. Three more ships of this class were laid down during the war, but their construction has been suspended since the war, presumably on account of the present uncertainty regarding the performance requirements of the small carrier.

Cruisers

As in the case of the carrier, one of the two main functions of the cruiser has undergone a considerable change with the elimination of potential enemy surface fleets. In pre-war days a large number of cruisers of the opposing navies accompanied their battle fleets for reconnaissance duties—fighting each other in an endeavour to gain information of the hostile battle fleet and to prevent the enemy from gaining information about their own. Under present conditions our potential enemy does not possess the necessary surface forces to dispute our command of the sea, but he has sufficient cruisers to attack our task forces when carrying out offensive operations against his territory, without which no war can be won. While, therefore, the carriers will provide the heavy artillery for offensive operations in enemy waters, it will be essential to have a strong force of cruisers with every task force. For the carrier cannot defend herself from attacks by other kinds of ships, particularly in foggy weather and at night, when her aircraft are unable to operate effectively. Cruisers are also still required for the defence of trade. In spite of her unfavourable geographical position, Russia will not hesitate to send out powerfully armed, fast ships, disguised as peaceful merchant vessels, to the focal areas of trade. Such ships can only be dealt with effectively by cruisers, the numbers required depending less on the number of vessels Russia has available for attacking trade than on the number of focal areas to be protected.

For these reasons the cruiser streng'h of the Royal Navy gives cause for much anxiety, unless we are to continue to rely on the United States Navy. We had sixty cruisers in 1939; now we have only twenty-six, including the old "Devonshire," which is used as a cadets' training ship. Labour front bench speakers have maintained that the generally accepted estimate in pre-war days of seventy as the number of cruisers we require is out of date in view of the changed conditions. But the number of focal areas of trade is no less, and there will be many task forces, all likely to suffer heavy losses. Our present number of cruisers is indeed insufficient for even our peacetime requirements, in view of the need to re-equip our ships with modern radar and gun control installations. With the "Birmingham," "Newcastle" and "Newfoundland" in hand for re-equipment last year, the Admiralty have had considerable difficulty in meeting the numerous calls for cruisers in all parts of the world. There can be no doubt that a powerful squadron of cruisers, sent on a peaceful visit to a foreign port in times of excitement, would have more effect than an anti-submarine frigate in bringing about a peaceful solution to the matter in dispute. It is thus very regrettable that work is still suspended on the three cruisers of the "Defence" class, laid down during the war, on the ground that a decision has yet to be reached about their armament. The Americans, it is noted, are not so undecided, for two of the existing United States cruisers are now to be fitted for launching guided missiles.



THE CRUISER H.M.S. "LIVERPOOL"

Destroyers

Before the ocean-going submarine came on the scene the destroyer's role in naval warfare was to attack heavy ships with torpedoes by day and by night and to prevent enemy destroyers attacking our own. They required a relatively heavy gun armament in addition to high speed and good manœuvrability. The latter qualities made them very effective for chasing and sinking submarines, and at the outbreak of world war II destroyers provided four-fifths of the total number of anti-submarine vessels we then had available. This was only made possible because the Germans had an insufficient number of heavy ships to engage in a fleet action. But the destroyer's heavy gun armament and good fighting qualities are not required for dealing with submarines, and these vessels were gradually replaced by the more economical and more suitable corvette and frigate, which were built in large numbers throughout the war.

Russia has even less need than Germany had in world war II of supplies from overseas, and it is in the highest degree unlikely that—should war break out—she will send her surface ships to sea in formed squadrons in an attempt to dispute our control of the sea communications. But her very large force of submarines and aircraft is a clear indication of her intention to try and deny to the Western Powers the use of the sea routes on which we depend for the transport of raw materials, supplies and armies. And although we have about 160 frigates remaining from the last war, very few of them are fast enough to deal with the modern submarine, which is capable of a submerged speed of 17 to 19 knots—as compared with 8 or 9 knots in 1939—when chased by an anti-submarine vessel. The Admiralty is therefore entirely right in converting forty-five of our existing 110 destroyers (over 40 per cent) into anti-submarine frigates—to supplement the present building programme of twenty-four fast frigates of a new design. Conversion represents the quickest and most effective method by which our ocean-going anti-submarine forces can now be built up.

The first of the destroyers to be taken in hand for conversion as an experimental

H.M.S. "ROCKET"—A FAST ANTI-SUBMARINE FRIGATE

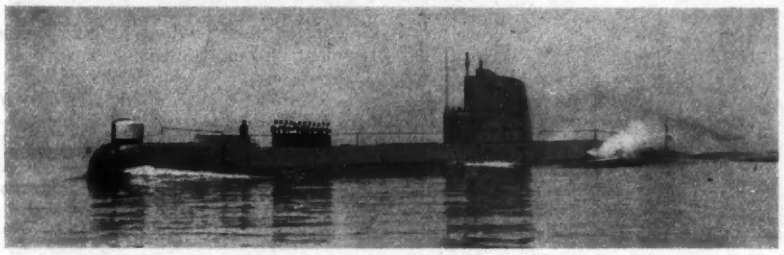
measure two years ago—the "Relentless"—has now done her trials and the remainder will all be completed by 1955, though some will have a simpler form of conversion without the refinements of the others. Conversion will give these ships a much larger radius of action, make them better sea-boats and provide them with a powerful anti-submarine equipment in lieu of their existing gun and torpedo armaments. We are thus left with sixty-five destroyers for task force operations in addition to the eight "Daring" class, of 2600 tons, which have been building since the war and will all have joined the fleet by 1955. Seven have now been launched. Russia is believed to have at least eighty vessels of this kind—ancient and modern—but the "Daring" class are likely to be the last ships which we shall build that are recognisable as the conventional destroyer, and the Admiralty seems confident that we have sufficient for our requirements.

Frigates and Lesser Surface Vessels

To overcome the U-boat menace in the 1939-45 war, the British Empire had to build 545 corvettes and frigates besides a vast number of smaller craft. We had time to build them because the Germans started the war with a total of only thirty ocean-going submarines, but even this number might have proved too much for us had we not been able to use the majority of our destroyers for anti-submarine duties. Since the war Russia has been concentrating on the construction of submarines under the supervision of German designers and technicians, and although a large number of her existing vessels are small and of pre-war design, with slow submerged speed, it is probably a safe estimate to credit her with 200 ocean-going submarines, many of them with an underwater speed of 17 to 19 knots. Indeed, when considering our requirements for dealing with them, all Russia's 200 ocean-going submarines must be credited with this high speed, since we cannot tell how they will be disposed.

It is thus none too soon that under the naval rearmament measures a large building programme of fast anti-submarine vessels has been commenced to replace our war-time frigates. The latter have not sufficient speed even to chase the modern submarine, still less to destroy her, which requires a large excess of speed. The very size of the programme—over 110 fast anti-submarine and minesweeping vessels—is a clear indication of the seriousness of our position, for it is being undertaken concurrently with the modernisation and re-equipment of a large number of our existing warships, the accelerated construction of the carriers and destroyers building since the war and with the need to maintain our peacetime economy. The new anti-submarine frigates are to be of two types, one costing about £1½million—as compared with £500,000 for a converted destroyer—and the other of a simpler design without all the refinements of the other, but none the less highly efficient as an anti-submarine vessel. The governing factor is the provision of the steam turbines, which are of a new design for working at higher pressures and temperatures than ever before at sea.

Progress is also being made with the development of a gas turbine unit for frigates and lesser craft, and already the first two of a new kind of motor torpedo boat with four 21in torpedo tubes—M.T.B. "5701" and M.T.B. "5720"—powered by Metropolitan-Vickers gas turbines in combination with diesel engines, have recently been launched. There have also been great advances in the diesel engine, and an improved engine with large horsepower has been designed for smaller craft, which is regarded as a development of the greatest importance. Apart from forty-two mine-sweepers of new design—to be added to the sixty-three existing ships—twenty-eight of the 150 small patrol vessels of various kinds included in the programme have already been ordered. The first of the four wartime frigates to be converted into surveying vessels is now on her station and a surveying vessel of an entirely new design, equipped with a hangar and a helicopter flight deck, was launched at the end of July. One new hospital ship has been authorised and another is planned, to be constructed as soon as labour and materials are available, which will be used by H.M. The King in peacetime as a Royal Yacht.



H.M.S. "TACITURN"—A RECONSTRUCTED SUBMARINE

Submarines

The loss of the "Affray" in April last and the earmarking for loan to the French Navy of four of our submarines have reduced our numbers of these vessels to fifty-one, no new submarines having been laid down since the war. Much work has, however, been carried out on our existing submarines to improve their performance, particularly in the re-design of the conning tower and upper deck casing and the removal of extraneous fittings to improve streamlining and thus to increase their submerged speed. Some of them have been given the additional battery power which is required for the high submerged speed of the modern submarine. It has also been necessary to fit new snorts to submarines of the "Affray" class. The "Affray" was found with her snort fractured and bent over and, whether or not this was caused by a surface ship hitting it, subsequent investigation proved that the metal of the snorts in all her class was defective. The reason why the submarine sank will probably never be discovered—it has been decided not to try to raise her—but it may well be that the sudden entry of water instead of air down the snort resulted in the diesel engine exhausting the air and so rendering the crew helpless before they could take action to save their ship. British submarines will again be of immense value for reconnaissance duties in enemy waters and for anti-submarine operations in the event of another war, but it is the anti-submarine aspect of submarine warfare which is our major naval problem, and it is only right that we should leave to the Americans, with their vastly greater financial and manpower resources, the development of submarines of new kinds. The United States Navy is, in fact, building two new types of submarines which are likely to present the defence with an extremely difficult problem. Both of them are to have turbine engines requiring no air, and if, as is believed to be the case, the difficulties of exhaust under pressure can be overcome they will be able to dispense with the snort tube and proceed for as long as desired at depths of 100ft, 200ft or 300ft.

One submarine is to be fitted with Walther closed cycle engines using hydrogen peroxide of 90 per cent purity as oxidant for fuel, and there is no reason to dispute the German claim—four U-boats were being fitted with this type of engine at the end of the war—that two such engines will give a submarine a speed of 25 to 26 knots. The other is to have a nuclear plant, using enriched uranium as fuel, for producing the steam for the turbine engines, and her speed may well also be in the nature of 25 knots, depending on the size of the turbine. The vessel will have an unlimited range, since no question of refuelling arises. According to unofficial reports from the United States—which must be accepted with reserve—the Americans attach more value to the nuclear plant than to the Walther cycle engine because hydrogen peroxide is none too safe for operational use and because the supply is likely to be limited owing to the great demand for its use in guided missiles. Whether the Russians are building either or both of these types is anybody's guess, but they certainly have had access, equally with their ex-allies, to the U-boats with Walther cycle engines. Moreover, the Nazi scientists—some of whom are presumably from Eastern Germany—were not far behind us in their knowledge of atomic energy.

(*To be continued*)

The Forest Products Research Laboratory

The Department of Scientific and Industrial Research has just issued a report entitled *Forest Products Research*, which summarises the work of the Forest Products Research Laboratory in the year ended December 31, 1949. The Laboratory now receives about 13,000 inquiries a year, and the report says that while practical inquiries are the lifeblood of a technological establishment and should not be restricted, their volume must not prevent a minimum amount of time being devoted to fundamental studies on which new technological advances depend. In the year reviewed in the report, there was a small increase in such studies. The report notes that much attention has been given to obtaining information on the properties and use of many unfamiliar Colonial timbers which are now coming into this country, and describes some of the tests made at the Laboratory on timber and timber structures. There is also some information on research work carried out on sawing and machining, which has included an investigation into the behaviour of sawdust in the gullets of saws in a variety of cutting conditions. Another investigation mentioned in the report is concerned with the rotting of timber in cooling towers. Hitherto, it is stated, it has been assumed that deterioration of timber in cooling towers was caused solely by the action of hot water. The mycology section of the Laboratory, however, has now discovered that fungi, while not the primary cause of the breakdown of the timber slats, play a part in increasing the rate of deterioration.

Civil Engineering in 1951

No. I

EVERY annual review of civil engineering must necessarily have many points in common with the previous year's review. Large civil engineering schemes take many years to complete, and cannot be dismissed on one occasion only. New schemes may take a considerable time to be launched, and it is not often that a scheme of any magnitude is started and completed within the same year. Economy in capital expenditure emphasises this trend by slowing down progress and allowing fewer new works to be authorised. Such a background of capital economy has been a characteristic of the civil engineering industry for the past few years, bringing new work virtually to a standstill in some branches of the industry and slowing it down in many others. Where the need is considered to be especially pressing, however, the capital can be found and the work goes ahead as it has done in the past few years with the construction of power stations, for example.

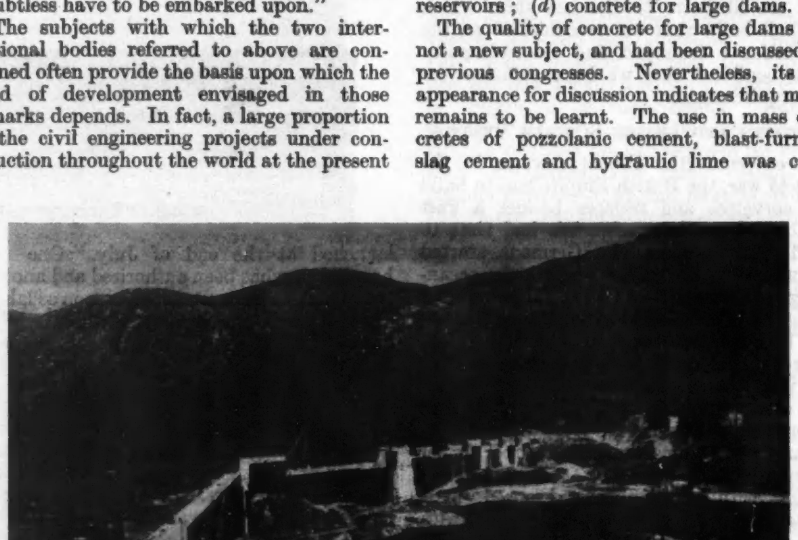
There were nevertheless certain aspects of civil engineering in 1951 which were quite novel. The Festival of Britain, for instance, gave civil engineers the opportunity to design and construct buildings of novel architectural character at the South Bank Exhibition. The presence of that novelty can, we think, be traced partly to the fact that the buildings—which are still in existence—are interesting engineering structures in themselves and partly to the fact that the architects were interested, architecturally, in the possibilities of newer engineering methods of construction. A second consequence of the Festival was the promotion of technical conferences and congresses, and the year was a particularly rich one in that respect. The most important of the technical meetings organised as part of the Festival was the Joint Engineering Conference held last June. The civil engineering papers presented at this conference were remarkable for the comprehensiveness with which each branch of the subject was covered, and provide an authoritative background of the present-day position in this country. Another event consequent upon the holding of the Festival was the Building Research Congress, an international congress held last September, in which many of the papers were primarily of engineering interest.

One of the year's most important series of meetings were those which took place early in the year in New Delhi, namely, a sectional meeting of the World Power Conference, which does not concern us in this review, the fourth congress of the International Commission on Large Dams, and the first congress of a new international body, the International Commission on Irrigation and Drainage. A great deal of attention is now being given to the problems of what are sometimes termed "underdeveloped" areas, and it falls to the civil engineer to solve many of them. The following brief extract from Mr. G. A. Maunsell's James Forrest Lectures* at the Institution of Civil Engineers last April sums up the matter: "Having regard to all the circumstances and pending the establishment of some kind of a world order to regulate population, there seems to be approaching a period of none can say how many years, but certainly a good many decades, during which the pressure of population upon the sources of food supply throughout the whole world is likely to bear rather heavily. One of the ways whereby this demand can be met is by bringing into cultivation some of those vast areas of the world's surface which cannot now be made use of. . . . Great potentialities for food production could be created in some of the desert areas and in the tropical rain forest areas, but before these territories can produce very much they require more or less intensive preparation and a great part of the preparatory work is of a kind which must be done by civil engineers. Developments at present inconceivable will doubtless have to be embarked upon."

The subjects with which the two international bodies referred to above are concerned often provide the basis upon which the kind of development envisaged in those remarks depends. In fact, a large proportion of the civil engineering projects under construction throughout the world at the present time are based upon the control and utilisation of water resources. It would appear that in the future such work will increase in importance. The formation of the International Commission on Drainage and Canals will therefore provide a valuable technical forum if it develops along the lines of the International Commission on Large Dams. The purpose of the new commission is given as "to stimulate and promote the development and application of the science and technique of irrigation and drainage in the engineering, economic and social aspects; the objects include all matters relating to planning, financing and economics of irrigation and drainage undertakings for the reclamation of lands as well as the design, construction and operation of appurtenant engineering works." The commission intends to accomplish its objects by the exchange of information between the various national committees, holding meetings, organising studies and experiments, publishing proceedings and other documents, and co-operating with other similar international organisations. The British National Committee of the commission has its headquarters at the Institution of Civil Engineers and its chairman is Sir William Halcrow.

The International Commission on Large Dams is by now a well-known body, and its periodical congresses provide a most valuable commentary on the progress of the technique of the design and construction of dams. Hydro-electric developments account for the majority of dam construction at the present time, and last year in the annual review of hydro-electric works we were able to comment on the general state of development of hydro-electric design as revealed by the papers presented at the World Power Conference in 1950. The fourth congress on large dams, which was held last January,† gives equally well an idea of the present state of development in the more restricted study of the dams themselves. The four questions discussed at the congress were concerned with (*a*) flood discharge and spillway design; (*b*) earth and rockfill dams; (*c*) silting of reservoirs; (*d*) concrete for large dams.

The quality of concrete for large dams was not a new subject, and had been discussed by previous congresses. Nevertheless, its reappearance for discussion indicates that much remains to be learnt. The use in mass concretes of pozzolanic cement, blast-furnace slag cement and hydraulic lime was commented upon, as was the resistance of concrete to freezing tests. In the design of thin arch dams, attributes such as creep and swelling or shrinkage of the concrete due to absorption or loss of water, were considered to be almost as important as changes of temperature and hydraulic load in offsetting the stresses induced. Earth and rockfill dams are becoming increasingly popular, although it appears that some diversity exists in methods of design and construction. One of the papers on these dams was published in abstract in THE ENGINEER of March 2, 1951.‡ The remaining two subjects, covering flood discharge, spillway design and the silting of reservoirs, are ones in which a great deal of interest is being shown. In particular, silting threatens to curtail the life of many existing reservoirs, and the papers before the congress included discussions on many aspects of this subject. In our issue of November 30, 1951, an account was given of the silting of reservoirs on the River Drac, in the French Alps, based upon two of those papers. As far as spillways are concerned, an interesting trend is that which balances the cost of a spillway against the cost of possible damage during an exceptionally large flood. Flood protection has also given rise to comment during the year on



MULLARDOCH DAM FROM THE NORTH

* THE ENGINEER, May 25, 1951, page 678.

† THE ENGINEER, Feb. 2, 1951, page 169.

‡ "Rock Fill Dams," by L. F. Harza.

account of the exceptional floods in the Missouri Valley of the United States§ and the River Po in Italy

Scottish Hydro-Electric Schemes

As far as constructional work is concerned, many projects for the generation of hydro-electric power or for more general utilisation of water resources, have been in progress throughout the world. Even in this country a substantial volume of work has been carried through this year in the Scottish Highlands to give some measure of relief to the shortage of electrical power.

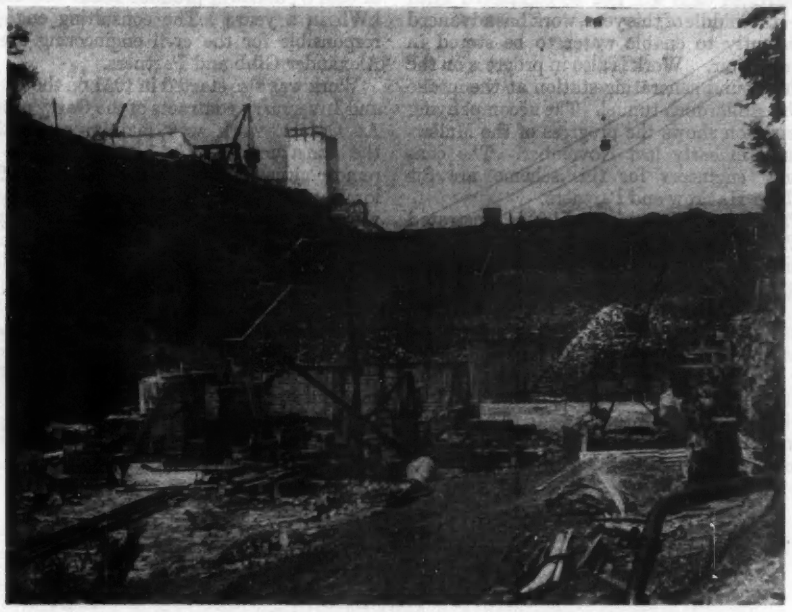
The North of Scotland Hydro-Electric Board has now installed 282,650kW of generating plant, capable of producing approximately 570 million units in a year of average rainfall, in its programme for the development of the water power resources of the Scottish Highlands. This new plant, together with other hydro-electric, steam and diesel plant in the board's area, is meeting the increasing demand for power in the Highlands and providing a surplus for export to Central Scotland, which this winter will amount to at least 185MW.

Altogether, the board has published details of twenty-three hydro-electric schemes involving the construction of forty-six generating stations with an installed capacity of about 788MW and an estimated annual output of about 2170 million units.

During 1951 the board brought into operation generating machinery with a capacity of 82,700kW at the Loch Sloy, Cowal, Affric and Gairloch hydro-electric stations and 3636kW of diesel-engined generators. Details of four new schemes were published during the year and have now reached the stage where negotiations are being started with local authorities, public bodies and private individuals affected. The largest is the Breadalbane scheme in Perthshire, which, by utilising a catchment area of 186 square miles, will produce an average annual output of 304 million units from seven generating stations. The Shin scheme in Sutherland, involving the construction of one main and five subsidiary generating stations, provides for the annual production of about 167 million units from the water power resources of an area of 250 square miles. The Orrin scheme in Ross-shire is the third stage of the Conon Basin group of schemes, which, when complete, will have six generating stations and seven main dams. The generating station of the Orrin section will have an installed capacity of 18MW, which, it is estimated, will produce 74 million units of power in a year of average rainfall. The fourth scheme to be promoted is a small scheme in the Pass of Kilmelfort, which will add 9 million units annually to the power available in Western Argyll.

Two small schemes which are likely to come into operation early in 1952 are the Lussa scheme in Kintyre and the Storr Lochs scheme in Skye. On both, the main civil engineering works were nearly completed at the end of the year and the generating plant was being installed. At the Shira scheme in Argyllshire the excavation for both the main and lower dams is well advanced and the main tunnel, having been holed through, is at present now being lined with concrete.

§ The Engineer, Aug. 24, 1951, page 238.



Digley Reservoir—Tailbay and Embankment

In October the last of the tunnels in the Loch Sloy scheme was driven. Some small collecting aqueducts still remain to be completed, however, before the full 32 square miles of catchment area can be harnessed. The construction of diversion aqueducts was also in progress at the Fannich scheme in Ross-shire, which commenced operation in December, 1950, and 7 miles of aqueduct, consisting of concrete pipes ranging from 48in to 72in in diameter, together with about ½ mile of tunnel, were being built. The aqueduct will utilise about 16 square miles of catchment having a value at the Grudie Bridge power station of about 22 million units annually.

The two power stations of Stage I of the Tummel-Garry scheme at Clunie and Pitlochry were operating to capacity during 1951. Over the period from March, 1951, until the end of the fish run in November at Pitlochry dam no less than 5600 fish were counted negotiating the fish pass from the glass observation windows, thus giving proof of the ability of salmon to negotiate fish ladders of the design adopted. On the Stage II works of the Tummel Garry project, which includes the construction of the Errochty power station on the shores of Loch Tummel, with an installed capacity of 75MW, the year saw further progress in the preparations for the construction of the Errochty dam, a large buttress dam, 1300ft long and 130ft high, and in the main tunnel, which is of 15ft 6in equivalent diameter and over 6 miles long, connecting the Errochty reservoir with the power station. Progress on the Errochty dam has now reached the stage where concreting should be in full swing by the spring of 1952. In the case of the tunnel, driving operations were in progress at six faces, and it is anticipated that the tunnel will be holed through from all faces early this year. The consulting engineers for the civil engineering work of the Fannich and Tummel Garry schemes are Sir Alexander Gibb and Partners.

Two of the three 22MW Francis turbine sets at the Fasnakyle power station of the Mullardoch–Fasnakyle–Affric scheme are now in operation and the third set will be started early in this year. The Benevean dam, the Fasnakyle tunnel and the Mullardoch tunnel are now in use, and although the

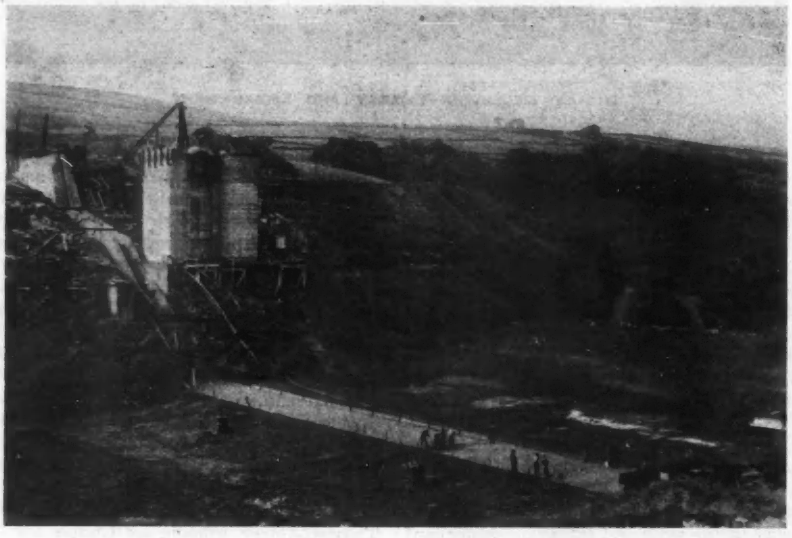
Claerwen Dam

Mullardach dam will not be completed until after the middle of this year, work has advanced sufficiently to enable water to be stored in the reservoir. Work is also in progress on the underground generating station at the intake of the Mullardoch tunnel. The accompanying illustration shows the progress of the Mullardoch dam early last November. The consulting engineers for this scheme are Sir William Halcrow and Partners.

The Glen Tarsan dam, which is illustrated in Plate 1, forms the reservoir of the Cowal scheme in Argyllshire. This scheme will supply the demands of the inhabitants of the Cowal district and the islands of Bute and Cumbrae, an isolated area of 508 square miles with a population of about 25,000. The power station is situated at the head of Loch Striven, a sea loch, and the turbines discharge directly into the sea. The tunnel connecting the reservoir and power station is some 4000ft in length, with an equivalent diameter of 6½ft. The gross head of the scheme is 400ft, and there are two horizontal Francis turbo-alternator sets, each of 3MW capacity in the power station; the annual output will be about 13½ million units. As may be seen from the illustration, the dam is a gravity buttress structure somewhat similar to the Loch Sloy dam. It has a height of 90ft and a length of 1000ft, the reservoir being supplied by a catchment area of 15 square miles, over which the rainfall averages about 80in a year. The scheme came into operation in September, although work still remains to be done to complete the dam and on various subsidiary works to divert water into the reservoir. The civil engineering consultants for this work are Messrs. Crouch and Hogg.

Work was started on four new projects in 1951—at Gaur and Lawers, in Perthshire; Garry in Inverness-shire, and the second stage development of the Conon basin, the Glascarnoch–Luichart–Torr–Achilty scheme. These four projects have a total capacity of 138MW and an estimated annual output of 522 million units. Twelve contracts were let during the year on the Glascarnoch, Luichart and Torr–Achilty developments, covering dams, tunnels, pipe-lines, power stations, &c., and by the spring of this year the work should be in full swing. This project will have a total installed capacity of 65MW, and will produce about 280 million kWh in a year.‖ The consulting engineers responsible for the civil engineering are Sir Alexander Gibb and Partners.

Work was also started in 1951 on the Quoich and Invergarry contracts of the Garry project. At Quoich work was mainly confined to the construction of a camp owing to the remote situation of the site. Driving of the low-pressure section of the Invergarry tunnel was commenced from each end. The pilot heading of the 24ft equivalent diameter diversion tunnel for the dam was holed through, and it is now being enlarged to full section. The Garry scheme involves the construction of two dams, one at the outlet of Loch Quoich and the other at the mouth of Loch Garry. A power station will be supplied from each of these dams, both power stations being equipped with vertical Francis turbo-alternator sets totalling 44MW, and producing some 170 million units annually, with a storage capacity of about 40 per cent of the annual output. The consulting civil engineers are Sir William Halcrow and Partners.



VALVE SHAFT, PUDDLE CORE WALL AND EMBANKMENT—DIGLEY RESERVOIR

Some Dams for Water Supply

The Claerwen dam, which is being built for the City of Birmingham Water Department, is now nearing completion, and it is expected that it will be finished during 1952. The dam is a mass concrete gravity structure, with an overall length of 1120ft and a height of almost 200ft, faced generally with masonry with some brickwork on the upstream face. It is shown in the accompanying illustration, which also gives a good idea of the constructional plant at the site.

Impounding commenced during April, 1951. During the year an aerial survey was completed which indicated that the dam will impound 10,600 million gallons of water. Work is now in hand on the construction of precast prestressed arch ribs to carry the roadway over the spill weir. Over 99 per cent of the concrete was placed, and the quarry and crushing plant was being closed down at the end of the year.

Two 10-ton Henderson cableways with travelling tail masts have been used throughout the work, and amongst other duties have placed the whole of the 372,000 cubic yards of concrete in the dam and transported a large portion of the masonry to the working faces. Various valves were installed during the course of the summer and the remaining valves are due to be fitted in the near future. The dam has been designed and the construction is being supervised by Sir William Halcrow and Partners, the contractors being Edmund Nuttall, Sons and Co. (London), Ltd., whilst the valve work has been supplied by Glenfield and Kennedy, Ltd.

Another interesting impounding work for water supply, construction of which was in progress during the year is the Digley reservoir, which is being built for the Huddersfield Corporation. The reservoir is situated in the valley of the Digley Brook, a tributary of the River Holme, about 8 miles south of Huddersfield. Its catchment area is about 2242 acres in extent, and the mean annual rainfall is 56in. The capacity of the reservoir will be about 700,000,000 gallons, and the available yield, after allowing one-third for compensation, will be about 3,000,000 gallons per day.

The dam consists of an earthen embankment about 900ft long, and the maximum depth of water to be impounded will be 136ft. The central trench, 6ft in width and about 1300ft in length, was excavated down to a stratum of shale which had been proved by exploratory bore-holes to be impervious, the maximum depth being over 200ft. The trench has now been refilled with concrete, and the embankment is being constructed. It consists of earthwork, with a central core of puddled clay.

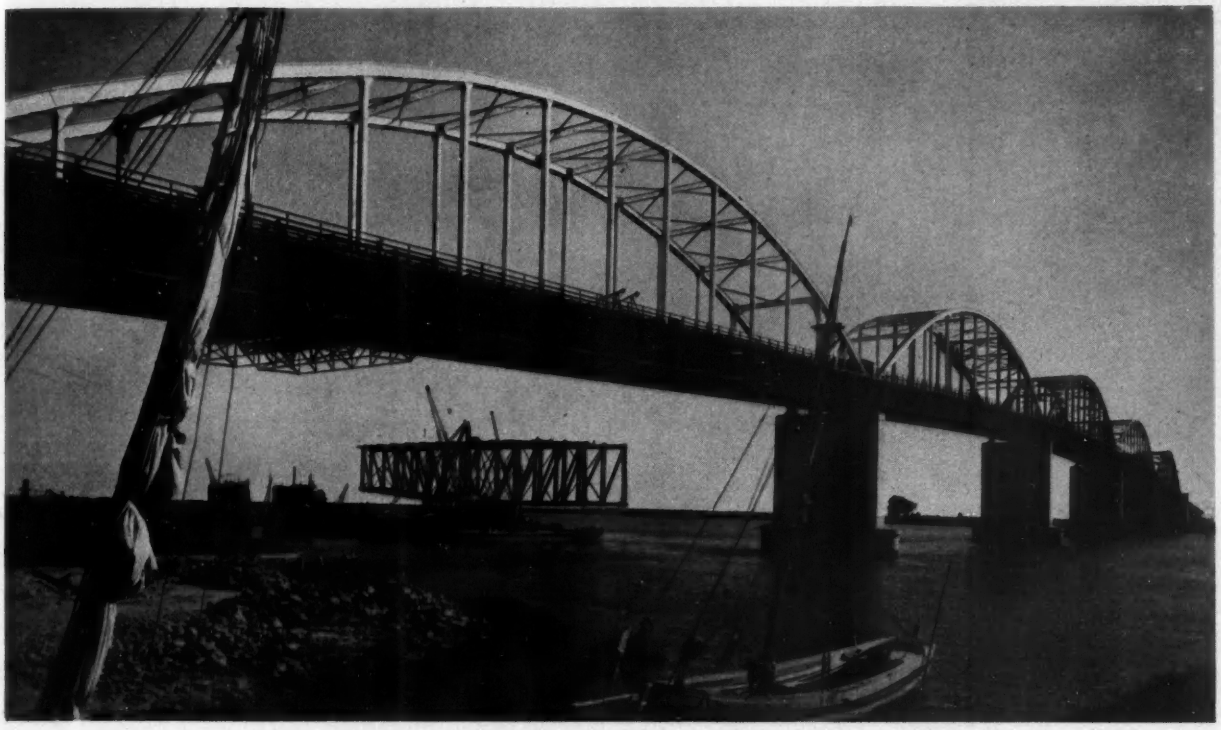
Water will be drawn from the reservoir through any one of four outlets, each of which is controlled by a hydraulically operated valve and a manually operated guard valve, all situated in the valve shaft. The lower outlet is 30in in diameter, the others being 24in in diameter. The water for supply and that for compensation are to be carried down the discharge tunnel, which is of arch and invert section, 12ft high by 12ft wide, in two cast iron pipe-lines, 30in in diameter. The compensation water will be discharged into the tailbay, and measured over two V-notches in the gauge basins, the amount being regulated by Larner-Johnson valves in the control house. A circular overflow weir, 64ft in diameter, will convey flood water down a vertical shaft to the overflow tunnel, which leads to the tailbay. At the end of the year, rather more than half the total quantity of 40,000 cubic yards of puddle was in place, and about 350,000 cubic yards of earthwork, out of the ultimate total of 550,000 cubic yards. The valve shaft was practically complete, except for the pipes and valves, and work was proceeding on the masonry in the overflow shaft and the tailbay. Two recent progress photographs of the work are reproduced herewith. The consulting engineers are G. H. Hill and Sons (Manchester), and the main contractors are Lehane, Mackenzie and Shand, Ltd.

(To be continued)

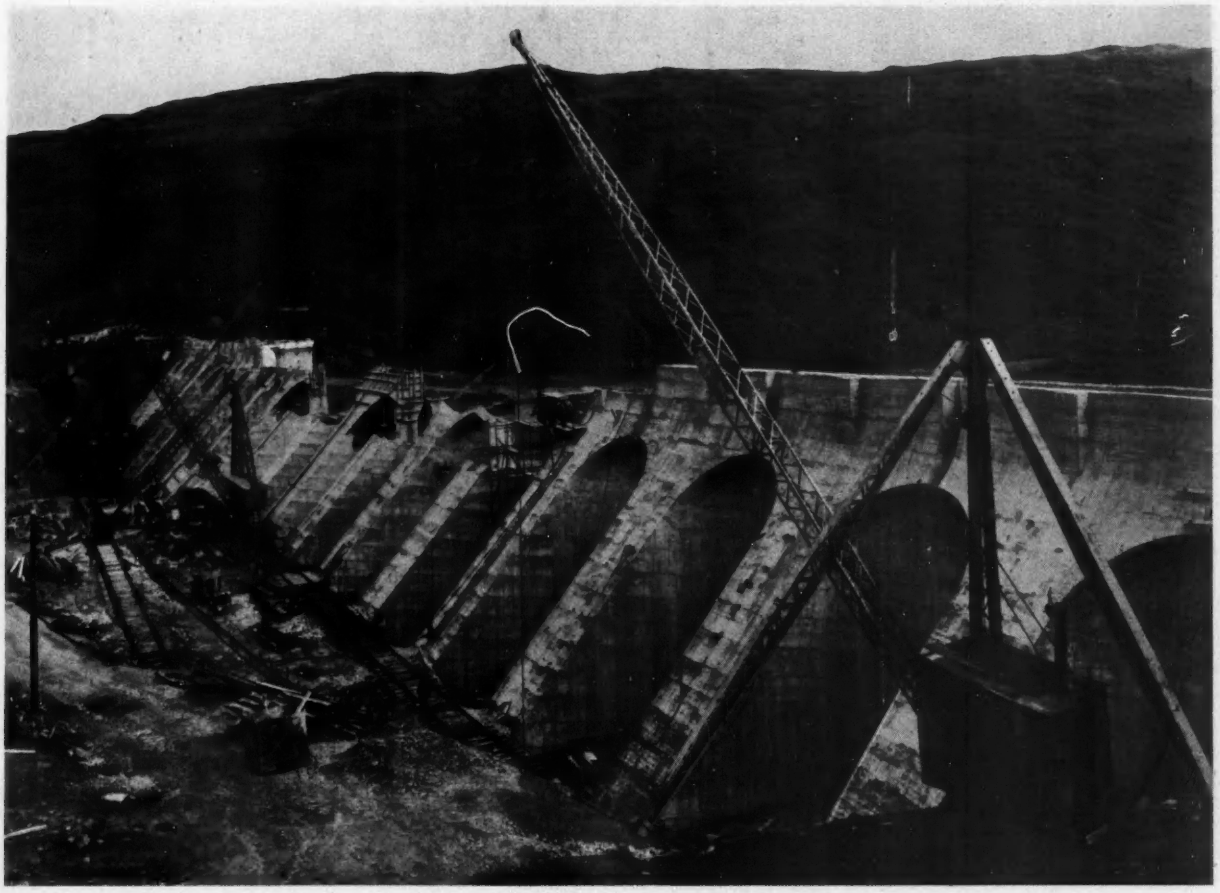
‖ See THE ENGINEER, June 8, 1951, for an outline of the development schemes for the Conon Basin.

PRESENTATION TO MR. SYDNEY HARVEY.—On Wednesday, December 12th, Mr. Sydney Harvey, the chairman of G. A. Harvey and Co. (London), Ltd., was presented with an illuminated volume to commemorate his completion of fifty years of service with the company. Mr. Harvey, the son of the founder of the company, in accepting this token of esteem and goodwill, said that much had been accomplished by the firm during the past half-century, and it had been made possible by the friendship and whole-hearted support of a grand team of willing and efficient helpers.

CIVIL ENGINEERING IN 1951

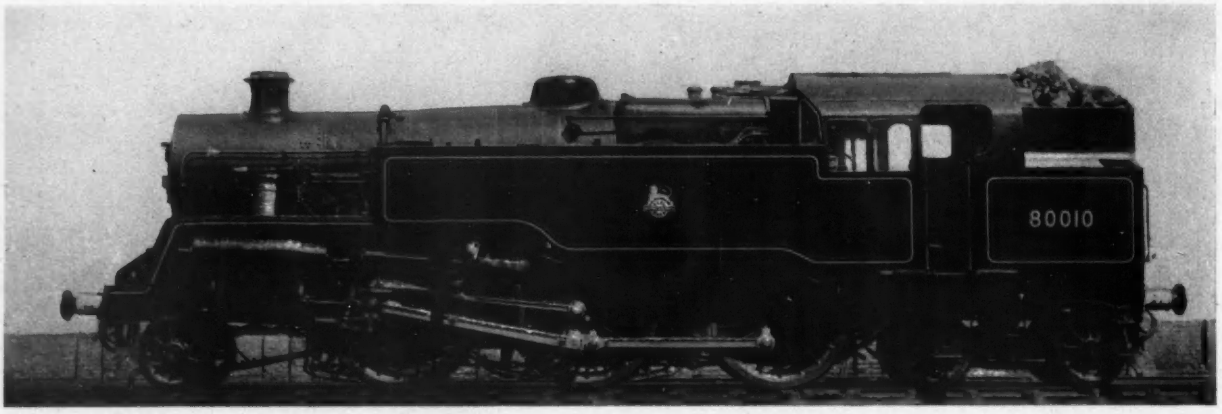


THE VILA FRANCA DE XIRA BRIDGE OVER THE RIVER TAGUS, PORTUGAL

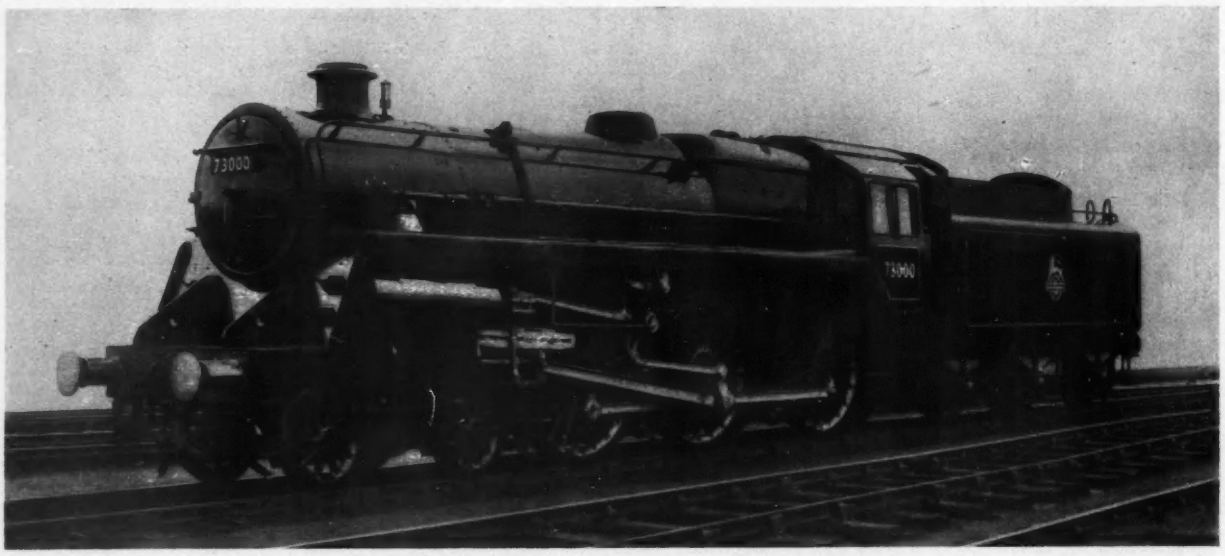


GLEN TARSAN DAM OF THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

BRITISH STANDARD LOCOMOTIVES OF 1951



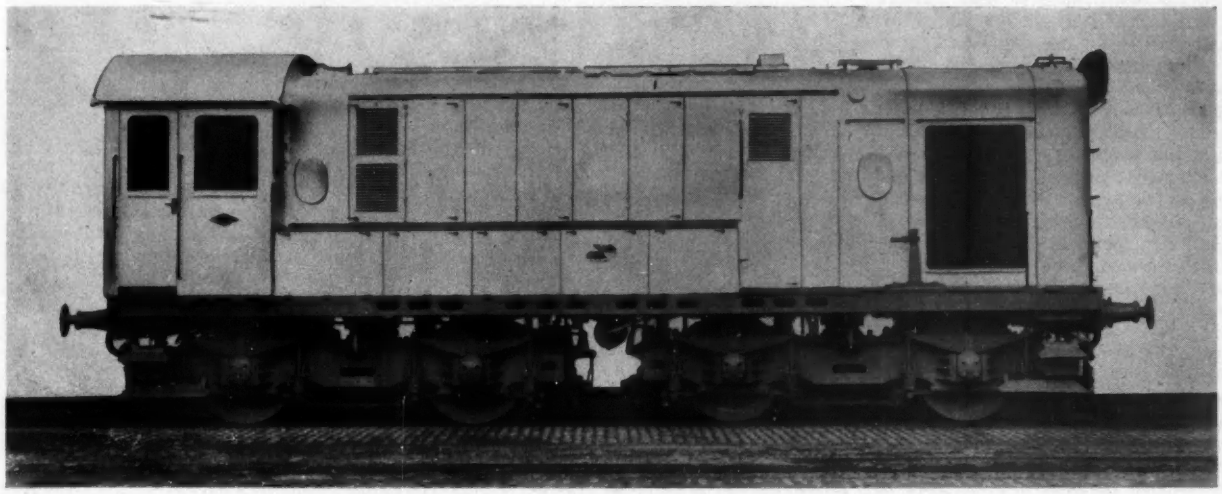
"CLASS 4" STANDARD MIXED TRAFFIC TANK LOCOMOTIVE



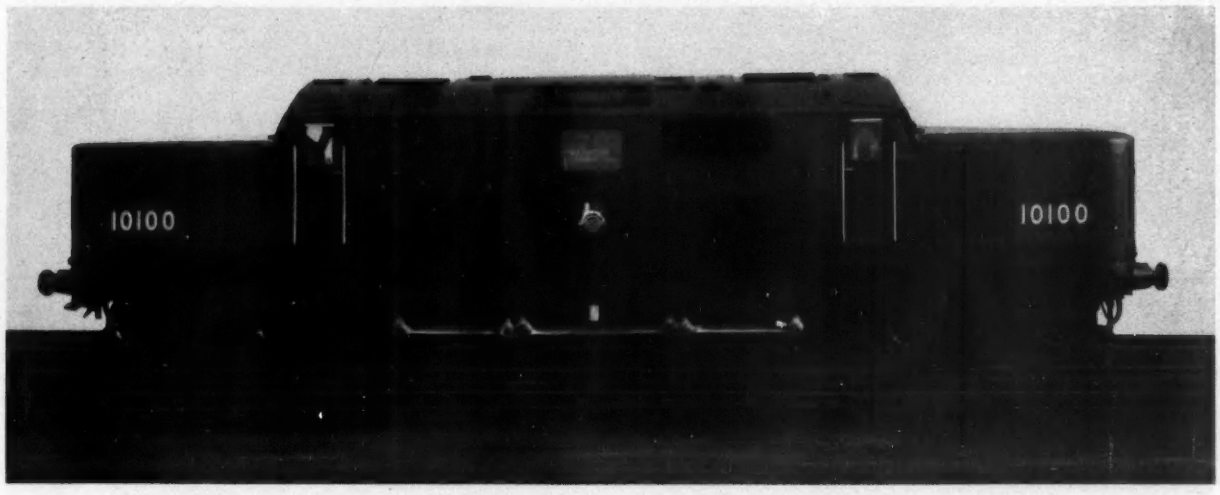
"CLASS 5" STANDARD 4-6-0 MIXED TRAFFIC LOCOMOTIVE

"CLASS 7" STANDARD 4-6-2 MIXED TRAFFIC LOCOMOTIVE

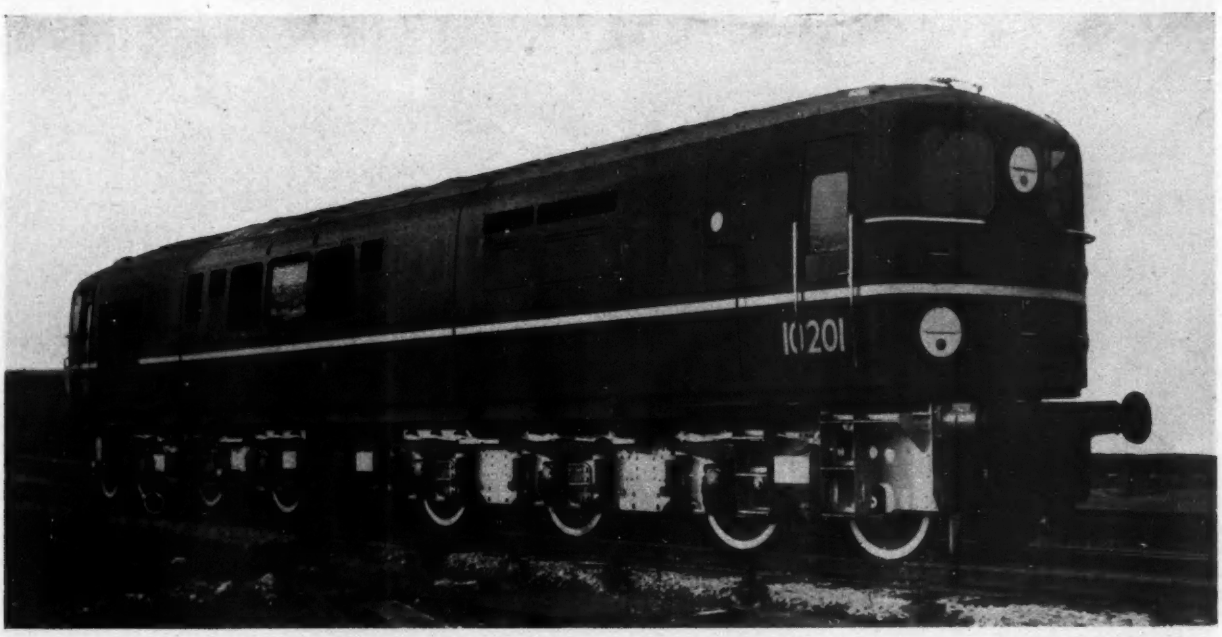
BRITISH DIESEL LOCOMOTIVES OF 1951



DIESEL-ELECTRIC SHUNTING LOCOMOTIVE FOR CEYLON



"FELL" DIESEL MECHANICAL LOCOMOTIVE No. 10,100



SOUTHERN REGION MAIN LINE DIESEL-ELECTRIC LOCOMOTIVE No. 10,201

WARSHIPS OF 1951

H.M.A.S. "ANZAC"

H.M.S. "RELENTLESS"

H.M. AIRCRAFT CARRIER "EAGLE"

Labour in 1951

By GERTRUDE WILLIAMS

No. I

WRITING at this time last year, I characterised the situation of the preceding twelve months as "uneasy but not as discouraging as it had been." I pointed out that the productivity of the country was increasing appreciably and that the dollar gap was no longer so formidably wide as to be a constant menace. True, the wage-freeze policy had been repudiated and, if wages rose rapidly, it would be impossible to maintain export prices at a competitive level, but, provided all parties kept their heads, there might be a hope of stabilising the improvement. Looking back a year later, it is easy to see that even this cautious and grudging optimism was unjustified; for the situation has deteriorated in almost every way. The dollar gap is now a yawning chasm, wage restraint is a thing of the past and prices have climbed steadily.

The Index of Retail Prices, which was 14 per cent above its base of June, 1947, in the autumn of last year has shot up to 29 per cent—which means that in this one year alone the rise has been as much as in the preceding three years taken together—and shows no signs of stopping there. The move has been practically continuous for the figure has never remained constant for more than two months at a time. Weekly wage rates have also risen by 21 per cent since June, 1947, in comparison with 10 per cent at this time last year, and it is obvious that the race between wages and prices has been getting merrily into its stride. So far prices seem to have won; but weekly wage rates do not, of course, represent the entire contents of the worker's pay packet. They take no account of changes in earnings due to alterations in working hours (with consequential increased pay for overtime, week-end work, night shifts and so on), nor for piece-work earnings due to variations in output or the introduction of new machinery, &c. Earnings have risen by very much more than 21 per cent. In the last calculation published by the Ministry of Labour and based on the figures collected in April, 1951, average earnings of all workers (excluding mines, railways and docks) were shown to have risen by 32 per cent, which meant that they had more than kept pace with the rise in prices. But it is no wonder in these circumstances that the cost of living, with all its repercussions, has been the dominant issue of the year.

Wage Claims

At the annual meeting of the Trades Union Congress in September, the cost of living took a large place in the discussions and a composite resolution on prices, profits and the cost of living, which was carried by a large majority, urged wider and more effective control of prices of home-produced goods, reconsideration of the Government's earlier declaration that it was opposed to any increase of subsidies, investigation into methods of distribution, more effective control of profits and the removal of purchase tax from household necessities. There are two conspicuous gaps in this list—any proposal to cut down the level of Government expenditure or to revert to the wage-freeze policy, despite Mr. Gaitskell's fervent plea for moderation in pressing wage claims, and there is no doubt that if these two had been included the resolution would not have got its large majority. Yet these two are the most potent factors in the inflationary movement of prices. When the year opened the railway unions were in the middle of pressing a major wage claim. For several years, indeed, the three railway unions had been carrying on unhappy negotiations, first with the companies and, since nationalisation, with the Railway Executive. After prolonged discussion the Railway Executive had, in the autumn of 1950, offered an all-round wage increase of 5 per cent on condition that the unions agreed to certain changes in working arrangements, e.g., a reduction in the number of separate grades so as to allow greater flexibility in staffing. The unions expressed the strongest objection in principle to proposals about working arrangements being introduced into the discussion of wage claims, no agreement could be reached and an appeal was made to the Minister of Labour for his assistance. All efforts on the part of the Department, however, were unsuccessful and a court of inquiry was set up late in December under the chairmanship of Mr. Guillebaud.

The Railway Wage Claim

The substance of the unions' claim was (*a*) that railway workers' rates had not kept pace with the rise in the cost of living as had wages in comparable occupations; (*b*) that, consequently, there was excessive wastage of manpower to other industries, and that it was impossible to attract the new recruits who were essential to the efficient running of the railways, and (*c*) that the shortage of labour led to an increase in overtime and Sunday working, the higher earnings of which were then quoted against them when they put forward a wage claim. The unions agreed that railway wages in the past had generally been lower than many others with which they might be compared because of the exceptional advantages enjoyed by railway workers in their comparative freedom from irregularity of employment; but this differential benefit was no longer of any importance, the unions insisted, in a world of full employment. They recognised that the railways were working at a loss, but maintained that this was due to the increased cost of materials and not to increased wages.

The Railway Executive, on the other hand, offered figures to show that weekly earnings were, in fact, very considerably above the basic rates, and that the payment to railway workers did not, if this were taken into account, compare unfavourably with that of other workers. Grade 2 porters, for example, whose basic minimum was 96s. per week, were earning an average of 118s. 11d.; class 1 signalmen, with a basic weekly rate of 120s., earned an average of 167s.; locomotive drivers, with rates ranging from 124s. to 138s., had average earnings of 166s., and so on. Nor were these extras due entirely to overtime. For example, extra pay for night work within ordinary hours would bring a regular addition of 10 per cent to the standard rate, and shift work and payment by results had similar effects. The Executive argued that it could not be expected to add to the cost of labour by improving conditions of service and then be denied the right to refer to these figures when wages were under discussion. In addition, they urged, it should be remembered that railway employees enjoy distinct advantages, even though their freedom from unemployment no longer differentiated them from other occupational groups. Few other industries offer comparable opportunities for promotion and the right to free travel to and from work within a 12 miles radius means a very considerable money addition to income in all urban areas. The financial position of the railways was so bad that the Railway Executive could not agree to even the 5 per cent increase in wages that had been proposed unless the men, in their turn, recognised that some changes in working arrangements were necessary; in particular, the abolition of the practice of employing staff to "call-up" men for early work, and greater flexibility in tours of duty, which might involve men in lodging a night away from home, provided every care was taken to see that suitable lodgings were available.

In its review of the issues, the court pointed out, whilst some degree of relativity in wage rates of different occupations must be maintained if an industry wishes to remain adequately staffed, yet there is an obvious danger to be guarded against if every increase that is conceded in one industry is used in support of similar increases elsewhere. Such action leads inevitably to the cumulative spiral of wages and prices, which, by wiping out all the value of the higher earnings, is detrimental to the interests of the wage-earners themselves, as much as to the rest of the community. And whilst such increases bring only the shortest term benefits to those who get them (only, that is, until the consequent rise in prices overtakes them), they are the cause of immediate and profound suffering to the large sections of the population—those living on pensions, for example—whose money incomes remain fixed.

In its unravelling of the tangled skein of negotiations that have been a feature of the railways during the last few years, the court pointed out that the unions have been pursuing divergent and conflicting policies. In view of the rise in prices there has been the natural desire to cushion the lower-paid workers as much as possible against reductions in their standard of living. At the same time there has been the insistence on the need, not merely to preserve existing differentials between these and higher paid workers, but actually to widen them. The extra pay earned by men doing more skilled, responsible or experienced jobs, is much less than it was before 1939 and this has reduced the incentive to take on these essential kinds of work. The railways, in common with most other industries, are suffering from a dearth of skilled personnel, which is directly attributable to the narrowing of wage differentials, and higher rates must be paid if an adequate supply of skilled staff is to be available. Each of these is a legitimate and sensible objective of policy, but they cannot be achieved simultaneously without involving the railways in prohibitive costs.

For some years the railways have been working at a loss and the court estimated that a rise of 7½ per cent, such as was demanded by the unions, would involve an additional cost of £12 million. Even this figure takes no account of the probable repercussions on the wage claims of other big groups, such as the railway shopmen, who were not included in the claim under investigation.

Finally, the court recommended that the offer of the Railway Executive should be accepted with the proviso that the increases

for some of the highest grades of skilled staff—signalmen, engine drivers, motor-men and such—should be rather higher than had been offered; but this recommendation was coupled with an equally strong suggestion that important changes in working arrangements should be introduced so as to make the use of manpower more efficient than it could be under existing schemes.

In the event the Court of Enquiry could have been saved its trouble for, threatened by a strike, the Transport Commission, the over-riding authority of the Railway Executive, gave way to the workers and conceded an all-round increase of 7½ per cent on receiving a promise from the unions that they would co-operate to improve productivity and eliminate the waste of manpower. This settlement is estimated to cost £12 million in a full year.

I have given some space to this enquiry because it illustrates so well the developments and problems of the present wage situation. Wages go up in one big section of the field of employment, prices rise in consequence, other workers feel the pinch and make demands to cover the higher cost of living and to keep level with those with whom they think themselves traditionally on a par, by which time the first group is ready to make a further demand and so it goes on. In every case the grant of higher pay is coupled with exhortations about increased productivity, whether by harder individual work or by changes in customary and often anachronistic working rules; but in every case the rise in pay is immediate or even retrospective, whereas the increased productivity, which should be its essential corollary or precursor, is left to protracted and often abortive negotiation.

Wage Increases

Recently the miners, after receiving an appreciable increase in rates and the grant of a special pensions scheme, have put forward demands for a further large rise and for longer holidays with pay, which are calculated to put another 4s. on the cost of producing a ton of coal; and have been granted both—13s. 6d. a week rise and an extra week's paid holiday; the railways, in addition to the rise just discussed, have recently been granted a further increase of 8 per cent on rates and the Railway Executive has already announced the consequential increase in freight charges; the Confederation of Engineering and Shipbuilding Unions having asked for a rise of £1 a week, have reluctantly agreed to the employers' offer of 11s., which is calculated to add £80 million a year to engineering production costs; the dockers' minimum daily rate has recently risen from 19s. to 21s., which will be reflected in shipping freights and the firemen have staged a two-day limited strike as a protest against the fact that their wages were not increased when those of the police force went up. By the time that all these increases have had their full effect on prices, every other industry will demand a rise to pay for the resulting higher cost of living.

It is obvious that this policy is unrealistic and cannot continue without leading to disaster. Everybody agrees, on paper, that more money in the pay packet is useless unless there are more goods to buy; everybody accepts the fact that this country is living beyond its means and that exports must be increased if we are to continue to receive essential food and raw materials; everybody tells everybody else that standards of living cannot be maintained whilst rearmament takes its toll of our resources unless more wealth is produced, but, in practice, everybody acts as if none of these statements had any relation to truth.

Coal Mining

There is no reason to pick out the coal industry as a special example of something which is so universal, except for its extreme importance to our economy. Before the war, in a year of depression and with heavy unemployment, we exported 40 million tons of coal. If only we could do that now, how much happier would be our position in world trade! Instead, we are actually importing at very high cost the one thing that we have always regarded as our most valuable raw material. The trouble is, of course, that we have not enough miners to produce the coal, though both domestic and world markets are hungry for it. After nearly three years of negotiation the National Union of Miners finally agreed last February to allow Italian miners, unemployed in large numbers in their own country, to work in England, provided the local lodges were ready to admit them to their pits; but even now there are only 300 Italian miners in the pits and only 1000 in training.

The miners' attitude of hostility to outsiders is not unintelligible and cannot be condemned out of hand. The twenty years between the wars have left a scar which is not healed; despite the booming conditions of the last few years, men are afraid that unemployment may still rear its ugly head and if foreign workers have once been accepted they cannot simply be turned away later, when they are not wanted and when they will add to the competition for scarce jobs. And though categorical promises have been given that, in the event of short time, foreign workers will be stood off first, it is feared that their availability will weaken the workers' case in resistance against wage reductions. But the real difficulty lies deeper than this: miners are a very close-knit community, with their own traditions and loyalties. In such a dangerous occupation the lives of hundreds may often depend on the close understanding of one another and on the intense sense of comradeship between them. It is not easy to admit strangers, however worthy in themselves, and strangers, in this case, whose language and customs and whose whole attitude to life are alien.

To explain is not to justify. Men must sometimes face innovations, however unwelcome, if they are demanded by necessity. But this particular innovation is not one that can be forced on an unwilling group of miners. Without the co-operation of the men in the pit the introduction of foreigners is bound to fail. How to get the co-operation is the problem and nobody knows the answer. In common with so many of our contemporary difficulties, it is a problem for the psychologist rather than for the economist; but in the meantime miners continue to demand—and to get—higher wages, higher pensions, more paid holidays, as if the number of men at work in the mines and the wealth from which these demands can be met had no connection with one another.

It is this blindness about the relationship between standards of living and levels of productivity that is the cause of a good deal of our trouble. We have got into the habit of thinking that standards must always be maintained or go up, but never, under any circumstances, be allowed to fall. Of course, the standards of many groups have, in fact, fallen and fallen appreciably. This is true of all people living on fixed incomes and of salaried persons whose individual or organised power has not been sufficient to force increases of pay proportionate to rises in prices; but the strongly organised groups have taken it for granted that it was enough for them to show that the cost of living had gone up in order to justify a claim for higher rates of pay. Hence the recent obsession with the cost of living figures (that played such a big part during the election campaign) and the many misunderstandings of the significance of the index of retail prices.

Wages and the Cost of Living

The retail index does not measure, and was never intended to measure, the cost of living, in the sense of the cost of maintaining a reasonable subsistence. It is simply an attempt to indicate the changes in the retail prices of those things on which people in the more modest income groups usually spend their money. A change in the price of caviare does not affect a working-man's budget; a change in the price of beer or tea does. By a nation-wide inquiry made in 1937–38 we found what proportion of the incomes of wage-earners was, on the average, spent on different classes of goods, and appropriate weights were attached to subsequent changes in prices, so as to ensure that changes in the prices of unimportant articles of expenditure should have less influence on the index than a change in the price of something which plays a big part in the household's budget. All that the retail price index does, therefore, is to show how much money would be required by a wage-earner to buy what would have cost him £100 in June, 1947, assuming the pattern of expenditure, i.e., the relative proportions of his income he spent on food, clothes, rent, &c., was the same as it had been in 1938. There is nothing sacrosanct about these proportions; they are merely what actually happened before the war. In fact, the particular pattern of expenditure mirrored by the index contained many modest luxuries, e.g., £21·7 of every £100 was spent on drink and tobacco, so that if a rise in the index took place without a compensating increase in income, a considerable shifting of expenditure from these items to more basic essentials would be possible before any actual want need be experienced.

This does not mean, of course, that every income contains this margin. The figures are based on averages. There are thousands of households which spend little or nothing on drink or tobacco, but the wage-earning population as a whole bought this amount in proportion to its expenditure on other categories of goods and services. Now a very large part of the rise in the prices of goods is due to indirect taxes and purchase tax. More than three-quarters of the price of a packet of cigarettes is simply tax, and the taxes on drink and tobacco together accounted, in the last financial year, for nearly £700 million of the national revenue. These taxes serve two purposes: purchase tax is intended to curb inflation by discouraging people from buying goods that are very scarce, and drink and tobacco taxes are time-honoured ways of collecting taxes from citizens, in a less obviously painful way than by higher income tax. Every such tax, by raising the prices of the taxed goods, sends up the price index so many points. If this is then made the justification for higher rates of pay, what happens? First, the purchase tax is ineffective in restricting demand and curbing inflation; and secondly, every person whose income is increased to cover the higher price level evades the taxation and shifts its burden on to somebody else—in the first place, to his employer and, finally, to the consumer of whatever he produces.

The harsh fact that we have to face is that we are not producing enough to maintain present standards of living and no amount

of increases in money incomes can alter this lamentable situation. The sooner reference to the price index ceases to function in wage negotiations the better for everybody. There might then be a greater likelihood of getting down to brass tacks.

Negotiating Machinery

A big change has taken place during the year in the machinery for settling industrial disputes, though it is one that has been anticipated for some time. Unofficial strikes had become so numerous that it was evident that the National Arbitration Order, 1940, no longer commanded the general consent that had been the basis of its success. It was beginning to be widely recognised that compulsory arbitration cannot be imposed by authority upon unwilling disputants because there is no practicable sanction which can be used against those who flout the law, and that the time was approaching when it must be abandoned. On the advice of the National Joint Advisory Council, a body composed of representatives of the British Employers' Confederation and the Trades Union Congress, this has been done by the Industrial Disputes Order (No. 1376), which came into force on August 14th.

The old Order (No. 1305), which was imposed primarily as a wartime measure, provided that, after all the voluntary machinery set up by agreement or established custom in an industry had been tried and failed, a dispute might be reported to the Minister of Labour and it was only if the Minister failed to refer the dispute within twenty-one days to the National Arbitration Tribunal that a strike or lockout might be declared. The new Order sets up a new body—the Industrial Disputes Tribunal—to consist of three independent persons, one of whom acts as chairman, and one representative each of employers and workers, chosen from two panels set up by the Minister after consultation with the British Employers' Confederation and the Trades Union Congress respectively. There are many important differences between its scope and that of the earlier body. (1) Whereas formerly any parties to a trade dispute might request the Minister to set the procedure in motion, this is now limited to "employers, employers' organisations and trade unions that habitually take part in the settlement of terms and conditions of employment through voluntary machinery." If no such machinery for collective bargaining exists, reference may be made only by the employer concerned and by the trade union that represents a substantial proportion of the workers. (2) There is no longer any legal limitation on the right to strike, but the Minister may discourage strikers by refusing to refer a dispute to the Tribunal if a stoppage has already taken place. (3) The Industrial Disputes Tribunal will not deal with disputes about the employment or non-employment of any person, or whether any person should or should not be a member of a trade union, so disputes about the "closed shop," for example, must be settled voluntarily. (4) As workers have regained the right to strike the employers are relieved of the general obligation to observe "recognised terms and conditions of employment," but a decision given by the Tribunal will become an implied term of contract between the employer and workers concerned until such terms are varied by agreement between the parties or by a subsequent decision.

The general purpose of the Order is to revert to the pre-war practice of settling disputes by voluntary machinery and, by limiting access to the Tribunal to official organisations, to strengthen the hands of the recognised trade union officials against "unofficial" leaders, who have come into such prominence whilst the unions' freedom of action has been restricted. Whether it will succeed in this purpose it is too soon to know. It was undoubtedly wise to rescind the old Order, for there is nothing more harmful to the general respect for law than to keep in existence a law which can be openly broken with impunity; but recent experience has shown that the transmission belt between union leaders and the rank and file is in need of a pretty thorough overhaul if breakaway action by groups of disgruntled men is to be prevented.

(To be continued)

The British Iron and Steel Industry in 1951

No. I

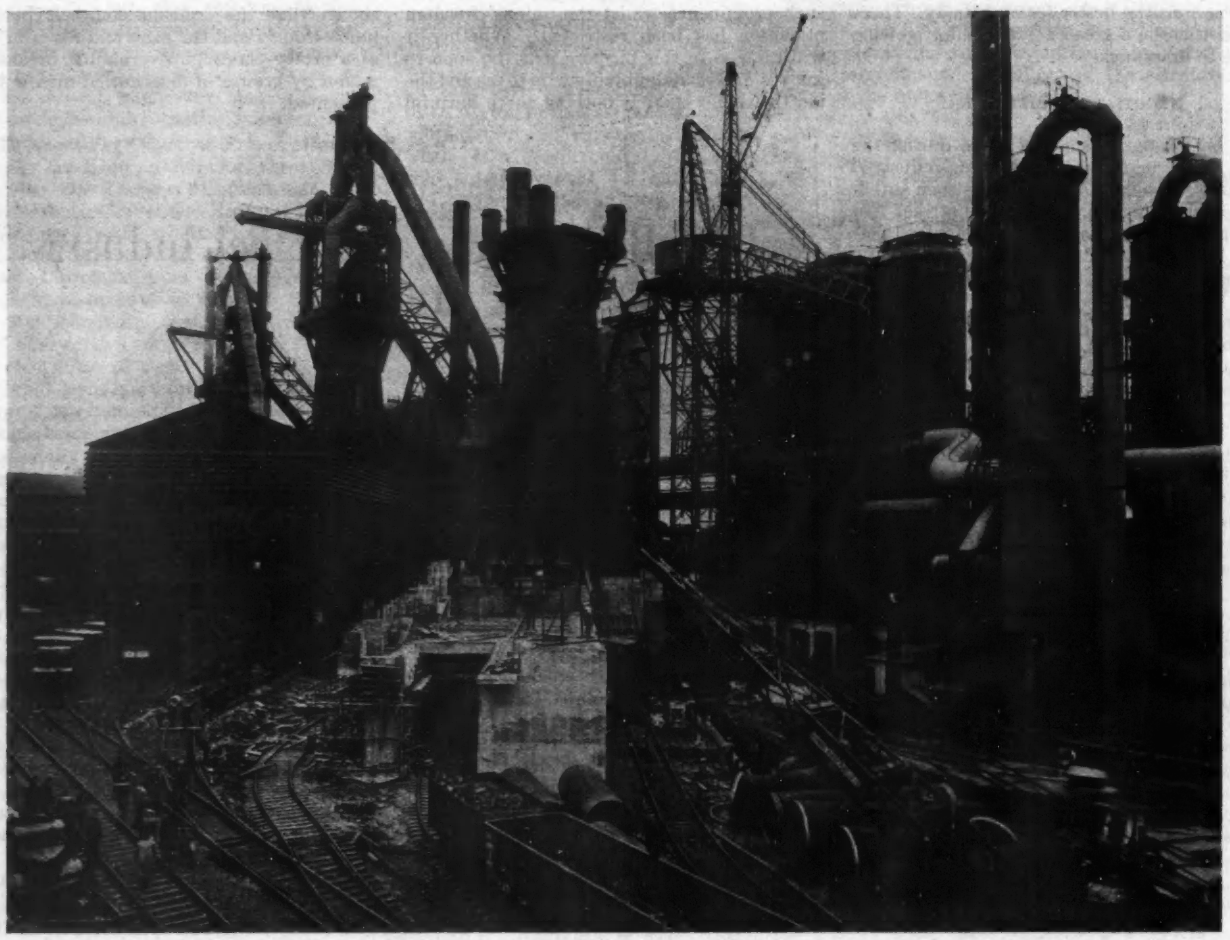
THE past year has been for the British iron and steel industry a time in which it has had to face the problems of public ownership, and a time also in which it has endeavoured to maintain as high a production as possible in the face of raw material shortages. Before 1950 ended the Iron and Steel Corporation of Great Britain had been constituted, in accordance with the provisions of the Iron and Steel Act, 1949, under the chairmanship of Mr. S. J. L. Hardie, and the late Government announced that vesting day would be February 15, 1951. On that day the Corporation became the sole stockholder of the eighty iron and steel companies specified in the third schedule of the Act, although those companies retained their individual identities and managements. The first statement made by the Corporation, following vesting day, was to the effect that it had not been able to reach agreement with the British Iron and Steel Federation on arrangements to cover the succeeding three months of an "interim period," during which a long-term organisation for the British steel industry was to be set up. The Federation, on behalf of the industry, had offered the Corporation the services, in a consultative capacity, of its president and three other leading steelmakers. The Corporation, however, was anxious to be represented on the Federation's council and executive committee, and took the view that the offer of consulting services did not go far enough. On "vesting day," in fact, Mr. Hardie expressed the hope that "at the appropriate time" the four additional members, whom the Minister of Supply was empowered by the Act to appoint, would come from within the steel industry.

This, then, was the atmosphere in which the British iron and steel industry began last year. At the same time, there was a general feeling that such an atmosphere and such a structure as that brought about by implementing the Iron and Steel Act could not last long in view of the slender majority in Parliament by which the last Government retained office. With the change of Government brought about by the General Election in October, it became evident that the newly-created structure of the steel industry would not be retained. When the new Parliament was opened early in November, the King's Speech declared the Government's intention to introduce a Bill to annul the Iron and Steel Act with a view to the reorganisation of the industry under free enterprise, but with an adequate measure of public supervision. During the debate in Parliament on the address in reply to the Speech an Opposition amendment regretted "the proposals relating to the iron and steel industry," and the Opposition expressed its intention of resisting at every stage any proposal to remove from the authority of Parliament "the broad, effective and positive control which it possessed over the iron and steel industry." The Minister of Supply pointed out, however, that the new Government remained sincerely convinced that the decision to nationalise the iron and steel industry had been a very grave error, and regarded it as a duty to restore conditions of free enterprise without which the industry would not be able to make its maximum contribution to the national output. If nationalisation were to continue, the Minister said, the Iron and Steel Corporation would have to become a great deal more active and gradually but surely the units of the steel industry would inevitably become less and less capable of independent initiative and action, and less and less flexible. The Minister then announced that, to cover the period which must elapse before the Bill to annul the Act could be introduced, the Government had decided to issue a statutory direction to the Corporation, under which the Corporation would not be able to take, without the written consent of the Minister of Supply, action which would result in "any alteration in the financial structure or management of any publicly owned company or of any other company under the control of the Corporation, or the sale or disposal of any part of the undertaking or securities held by any such company." That step, which was taken by the Government after consultation with the Corporation, would, it was felt, hold the position pending the passing of legislation to restore that measure of freedom which is so essential to the iron and steel industry at the present time.

Output

The big demand for steel, accentuated by the requirements of the rearmament programme, made it essential that production should be maintained at as high a level as possible, throughout last year. In each of the four preceding years the actual production of ingots and castings had exceeded the forecast made by the Government. Steel output in 1950 amounted to 16,292,700 tons, and the output of pig iron totalled 9,498,500 tons. The record steel production in 1950, however, was materially assisted by the large quantities of scrap which the industry had been able to obtain from Germany. Before the end of 1950 there had become apparent a marked deterioration in the raw materials position. At the beginning of last year pig iron stocks totalled 470,000 tons and stocks of scrap 618,000 tons, compared with 526,000 tons and 813,000 tons respectively at the beginning of 1950. Taking into account the increased capacity for iron and steel making during 1951, it was estimated early last year that 16,750,000 tons of ingot steel could be produced in this country if full supplies of raw materials were available, but it was realised that it would be difficult to obtain sufficient imported scrap and rich iron

BLAST FURNACES AT THE MARGAM WORKS



ore to keep the capacity fully employed. Accordingly, the Government forecast, given in the Economic Survey, was a crude steel production of not more than 16,000,000 to 16,250,000 tons—a forecast that was acknowledged to be optimistic. At the time of going to press with this issue the production figures for the whole of 1951 are not available, but in the first forty-eight weeks, to the end of November, the output of steel ingots and castings was 14,488,000 tons, compared with 15,107,000 tons in the corresponding period of 1950. In the first six months of last year steel output totalled 8,153,000 tons and was thus at an annual rate of 16,306,000 tons, which was about 300,000 tons below the annual rate during the first half of 1950. But in the first five months of the second half of last year production amounted to 6,335,000 tons, which represented an annual rate of about 15,200,000 tons. It is unlikely, therefore, that total steel production for the whole of last year will have reached 16,000,000 tons.

The lower total output for last year, however, is by no means an unfavourable reflection upon the British steel industry. It has done its utmost, under difficult circumstances, to maintain a high rate of production and to procure as much raw material as possible. The principal obstacle to greater production in 1951 was undoubtedly the shortage of raw materials. The continued extension of blast-furnace, ore treatment and sintering plant, and improved ore unloading and handling facilities made a useful addition to the country's ironmaking capacity, and more home-produced ore became available during last year. During the first ten months of last year, in fact, the weekly production of home ores averaged 282,200 tons, compared with 247,500 tons in the corresponding period of 1950. In the early part of 1951, however, supplies of imported ore were much less favourable, the situation being aggravated by the necessity to obtain coal from abroad. Ships had to be sent, frequently in ballast, across the Atlantic to bring in the coal needed to stave off another fuel crisis. The ore trade was particularly hard hit, as the ships used to import the coal were generally those most suited for the carriage of ore. In the early part of last year, up to the end of May, about 1,121,000 tons of coal were imported into this country, but in the same period it was not possible to bring in more than 3,609,000 tons of iron ore, an amount nearly 600,000 tons short of the total imported in the corresponding period of 1950. In addition, as has been emphasised on several occasions, coal is an important bargaining counter in bilateral trade negotiations. Bigger exports of coal to some overseas countries would lead to bigger imports of rich ore to this country. In order to maintain blast-furnace output in the early months of last year it became necessary to draw upon the stocks of imported ore which the iron and steel industry had built up, and the steady improvement in imported ore arrivals during the latter half of the year was particularly welcome. By the end of November, last year's imports of iron and manganiferous ores had reached 8,063,313 tons, compared with 8,404,800 tons for the whole of 1950.

Scrap supplies last year were a much more serious limiting factor upon the steel industry's output. In the first eleven months of 1950 it was possible to obtain from abroad—mainly from Germany—2,004,336 tons of scrap, but in the first eleven months of last year imports of scrap into this country amounted only to 617,575 tons and, when the figures for the whole year are complete, the total will obviously be less than one-third of the quantity received in 1950. With the greatly reduced imports of scrap from Germany and the increased competition for scrap all over the world it became imperative that the maximum amount of steelmaking scrap should be procured from home sources. In 1950 scrap consumption had amounted to 10,251,000 tons. The amount of scrap arising in steel works during 1950 was 4,210,000 tons and the amount procured from other sources in this country was 3,950,000 tons. But to meet scrap requirements in 1950 stocks had to be drawn upon to the extent of about 240,000 tons, and at the beginning of last year the stock figure stood at no more than 618,000 tons. Last January, therefore, the British Iron and Steel Federation, in conjunction with the Joint Iron Council and the Scrap Merchants' Federation, initiated a special campaign urging the quick return of all process scrap, and suggesting that, wherever possible, decisions should be taken to scrap obsolete plant and machinery, have it broken up, and quickly returned to the steel furnaces. The idea behind the campaign was, of course, that there should be an additional effort to speed up the rate of scrap flow. At the beginning of last year the weekly receipts of home scrap were about 157,000 tons a week, and by the campaign it

was hoped that another 10,000 tons a week would be added to that figure. In the earlier part of last year that hope was being fulfilled, although by the time the year ended it was not possible to say that an additional 500,000 tons of scrap had been raised from home sources. Throughout the year, however, the importance of the scrap drive was repeatedly emphasised, not only by the British Iron and Steel Federation, but also by many other trade associations, and in Parliament. The campaign to encourage industry and the nation to become more and more "scrap-conscious" continues.

Steel Distribution and Prices

In 1950 steel supplies were adequate to meet essential home requirements and to provide nearly 2,500,000 tons of finished steel for export, and at the beginning of last year deliveries of steel to home consumers were rather bigger than they had been a year previously. But in the early part of last year it was possible to augment the current output of finished steel by drawing on producers' stocks of ingots and semi's, which had been built up to a high level in 1950. Before many months had passed, however, the increasing requirements of the armament programme became more and more pronounced and steel users found the supply position getting more and more difficult. In view of the rearmament programme, the problem of providing sufficient steel to meet home and export commitments was still an acute one as the year ended. The quantity of imported steel reaching this country during the greater part of last year was smaller than in the preceding year, and our exports of steel were also reduced. Throughout the year distribution of steel sheet, tinplate, terneplate and blackplate continued to be controlled, and in August the Ministry of Supply announced that, from December 3rd, control over the distribution of all the main descriptions of carbon steel would be reintroduced. But in November, it was stated that distribution control would begin on February 4, 1952, the arrangements being very similar to those which operated up to May, 1950.

After a period of price stability extending over nearly two and a half years, an Order was made in August last authorising increases in the controlled maximum prices of iron and steel products. These increases brought the general level of steel prices in this country to about 130 per cent higher than that of 1938. Price stability has long been a policy of the British steel industry, but in the last year or so there have been sharp rises in the prices of imported iron ore, scrap, pig iron and semi-manufactured steel. At home there were increases in wages and in transport, scrap and fuel costs, which had to be met, and all these factors, of course, added considerably to the overall costs of the steel industry. Furthermore, the loss arising from buying finished steel abroad and selling it in this country at home prices, had hitherto been borne by the Exchequer. That loss had risen steeply within the increase in world prices and in the middle of last year the Government decided that to avoid an increase in the subsidy, the trading loss, but not the import duty, should be recovered by an adjustment spread over home controlled prices of iron and steel. That item, it was explained, accounted for over 20 per cent of the overall price increases which were made last August. In spite of the increases, however, British steel prices remained fully competitive with those ruling in Western Europe and a good deal lower than prices prevailing in the U.S.A.

Efficiency of the Steel Industry

The post-war increase in the efficiency of the British iron and steel industry was well maintained throughout last year. The improvements which have been made can, of course, be measured in various ways. As one example, the amount of coal required, on the average, to produce a ton of finished steel was reduced from 37·8 cwt in 1948 to about 34 cwt by the beginning of last year. Again, labour productivity in steel melting and rolling (1938=100) improved to 139·3 by the end of 1950 and to 148·8 by the middle of last year. The continuous working week, which was adopted in April, 1947, has remained in operation and the excellence of the steel industry's labour relations continues unimpaired. The British iron and steel industry is proud of the fact that it has suffered no major strike or lock-out within living memory. The number of process workers and general and maintenance workers associated with them was, towards the end of last year, about 262,730. The progress made with the steel industry's development plan has, of course, greatly assisted the improvement in productivity. The present plan, which is due to be completed in 1953–54, originally envisaged a total expenditure of about £168,000,000 but, by the beginning of last year, on account of price increases, that figure had risen to at least £240,000,000. More than half that sum has now been expended, although it is not possible to say at the moment how much was spent in steel works development and modernisation during 1951. Work on the preparation of a second development plan, based on the knowledge and experience gained in carrying out the first, has already been started by the British Iron and Steel Federation.

By far the largest item in the current programme is the development in South Wales, which was put in hand in 1947 by the Steel Company of Wales, Ltd. The plans adopted involved the reconstruction and extensions of the blast furnaces, coke ovens and coal and ore-handling plant at the Margam steel works in order to increase the output of pig iron to the required amount. It was intended that these works at Margam should supply the new Abbey works adjoining, in which an 80in continuous strip mill would be installed, together with a melting shop and ancillary plant. The plan was that these two plants should form one integrated works, which, when completed, would extend for 4½ miles and be capable of an annual steel production of 1,500,000 tons. An integral part of the scheme was the laying down of a cold reduction mill alongside the continuous mill at Margam and a second cold mill, with a new tinplate plant, at Trostre, near Llanelly. When the project was put in hand the cost was estimated at £60,000,000. The Margam and Abbey works were officially opened on July 17th last, and a full description of the work so far completed was printed in our issues of November 2, 9, 16, 23, 30, December 7 and 14, 1951.

The lower view on Plate 6 shows the Margam works from the rail sidings, and an illustration on this page is of the blast furnaces. Nos. 1 and 2 furnaces are shown in the background of this picture and in the foreground there is illustrated the No. 3 furnace under construction. The reconstruction of No. 1 furnace was completed in 1946. The furnace has a hearth diameter of 21ft 6in. The second furnace came into commission in November, 1950, and is the largest yet built in Great Britain. Its 25ft 9in diameter hearth is lined with carbon blocks, which are carried to a point above slag level. No. 3 furnace is a duplicate of No. 2, and when the reconstruction scheme is complete the new plant will be capable of producing over 1,000,000 tons of iron a year, with the use of foreign ore. No. 1 furnace has fourteen tuyeres, evenly disposed between seven columns, and the other two furnaces each have sixteen tuyeres and eight columns.

Mould Preparation Bay at The Abbey Works

At the new Abbey works of the Steel Company of Wales, Ltd.—covering an area of about 550 acres—the principal production departments have been arranged in four large buildings. An accompanying illustration shows the mould preparation bay, with the melting shop in the background. The melting shop includes a raw materials and scrap box filling bay, a charge-holding bay, a furnace bay and a casting bay. It is 1870ft long, 397ft wide and has a maximum height of about 89ft over the furnace and casting sections and 69ft over the raw materials, scrap filling and charge-holding bays. A mould preparation and general stores building has been laid down between the top ends of the melting shop and the

main mill building. In this mill building, which has one bay 4008ft long by 100ft wide by 68ft high, the ingot stripper section, soaking pits, mill and plate finishing section, are arranged. Adjacent to the mill, and under the same roof, there are a 54ft high slab furnace bay and two covered slab yards. Two bays, each 1400ft long, at the side of the plate finishing section, are laid down for sheared and coiled sheet processing. A cold mill has been laid down as a self-contained unit in a separate five-bay building adjacent to the processing end of the main mill. In this building the centrally disposed mill bay, which is about 1000ft in length, is flanked on one side by an annealing and pickling bay and on the other side by processing and inspection and dispatch bays. By the end of last year the plate and hot sheet finishing departments, together with the cold reduction plant at the Abbey works were in process of commissioning.

Another extensive project in the iron and steel industry's development programme is that concerned with the reorganisation of the Scunthorpe, Lincolnshire, works of John Lysaght's Scunthorpe Works, Ltd. The scheme, a large part of which has now been completed, includes the construction of new coke ovens, enlarged open hearth furnaces, soaking pits and a new blooming mill and continuous billet mill. The upper view on Plate 6 shows the first of the two cooling towers for the new power house at the Scunthorpe works, the new 22ft 6in hearth diameter blast furnace, with two stoves completed and the third nearing completion, and the new gas cleaning plant, which has been constructed. In the foreground of the illustration there can be seen the old hot bank building, which is being dismantled.

(To be continued)

Atomic Energy in 1951

IMPORTANT developments during the year have included the recently reported technical advance in the strategic weapons which make use of atomic energy, and the increasing realisation of the many troublesome problems which still await solution before there can be any effective use made of nuclear energy for the production of power for civil purposes. Even when these latter puzzles are solved, as one day they must be, there will still need to be tackled the vexed problem of the right sort of international control to give the minimum of military risk with the maximum of convenience and efficiency in commercial operation. These two aspects of the uses made of atomic energy must be separately considered.

During the period under review there has been little sign of any such amelioration in the international situation as would ease the path of those who would like to see the civil applications of atomic energy more rapidly developed. At the moment the first call on the research organisations concerned must needs be for those developments which have a direct bearing on defence preparations, and these as a rule make only a fortuitous contribution towards civilian objectives; though should there result from the military programme the development of a mobile power unit able to operate for an appreciable length of time, without refuelling, certain kinds of naval vessel and the larger forms of civil aircraft might equally be served.

Civil Power Supply

Nevertheless, the general field of investigation does in the meantime include, though on a lower experimental priority, the objective of finding an alternative source of energy to supplement, perhaps even ultimately to replace, the existing natural sources of power. In a recent issue of the *British Atomic Scientists' News*, Sir John Cockcroft, the Head of the Atomic Energy Research Establishment at Harwell, sets out the individual technical problems which he considers must first be solved. One of these is how to generate heat at a temperature high enough to afford a satisfactory ratio of conversion of heat into power; this requires the uranium elements to operate at a temperature of not less than 500 deg. Cent. Further, these elements must have a metal sheathing which will stand these temperatures and not be unduly attractive to neutrons, a requirement which turns out to be very restrictive. The next point is the exceedingly difficult heat transfer problem: if it involves the use of liquid metals, which might otherwise be very convenient, it raises its own problem of the resulting radio-activity produced in such liquids. The next problem cited by Sir John is that of a mechanism to enable the fuel element to be changed, with safety to the operators concerned, when necessary; the next is some method of maintaining blowers and pumps in proper condition despite their intense radio-active contamination, and the final problem is the ever-troublesome task of disposing of radio-active refuse from the operation of the plant. Considerable as are these technical difficulties, the Harwell view is one of cautious optimism, though it is hardly expected that the coming of nuclear power can feature in an important way in much less than a couple of decades. By that time the cost and availability of coal are each likely to differ materially from the conditions of to-day; but it hardly seems probable that the coal supply position will have become any better than it now is, in which case the cost of nuclear fuel might be found to be substantially less than that of coal. Indeed, if the very important work in hand in more than one country on the development of breeder reactors meets with the success hoped for, the future of nuclear fuel may take a very favourable turn. The great advantage of these forms of reactor is that the capacity for "burning" the uranium might rise substantially, in the limit by as much as a hundred-fold, in which case the problem of the cost and availability of sufficient uranium supplies would almost vanish. But information released during the year seems, on the whole, to indicate that there may prove to be rather more difficulty in producing efficient breeding reactors than had been hoped; the data at present available are, however, still inadequate for the formation of a definite opinion, for or against. Incidentally, it is an oddly paradoxical situation of these present days that, as Mr. Gordon Dean, the chairman of the U.S.A.E.C. has pointed out, the world's greatest single customer for a supply of mechanical energy is at the moment the American atomic energy project itself!

As we announced in a recent issue, the first atomic central heating plant to be installed anywhere in the world has lately been put into use at the British research station at Harwell. This enables a building containing eighty offices to be heated from the operation of the large experimental atomic pile known as BEPO. Eventually two, or perhaps three, other Harwell buildings, will be provided with similar heating systems, with the result that the annual saving in fuel will be raised from the present useful figure of 250 tons of coal to as much as 1000 tons.

Health Hazards and Radio-Activity

There has been a certain amount of exaggeration about the effects of radio-activity on the human body; since that body has had for long to accustom itself to a daily dose of radiation from the inescapable cosmic rays which arrive steadily by day and by night, a considerable degree of immunity has, as might naturally be expected, been acquired. Moreover, it is estimated that the integral yearly dose received by the Harwell staff in the course of their work is less than 1 per cent of that received by the general population from cosmic sources. Mr. Dean reports a much better standard of health in the U.S. atomic energy industry than in other national industries; no doubt a result of the greater care taken. Hence there is no need for alarm because of any special degree of hazard necessarily and unavoidably associated with atomic energy enterprises.

The Work of the U.S. Atomic Energy Commission

No country can rival the energy and resource thrown by the United States authorities into the atomic energy problem as a whole. But it is well to bear in mind that, although the British effort, centring in the research establishment at Harwell, was started only five years ago, it already deals with the general field covered by the Argonne, Brookhaven and Oak Ridge research stations of the United States, and is of the same general size as any one of those laboratories and has, moreover, a good and effective staff in the fields of chemistry, chemical engineering, metallurgy and physics.

In the latest report of the American Commission opportunity is taken to review the procedure followed in pursuance of the wide discretion allowed by the American atomic energy Act of 1946. It had the choice between the alternatives of direct operation—as in the case of the great Tennessee Valley enterprise—or of making use of contract procedure, the contractors being sometimes firms and sometimes universities. In most instances the latter is the procedure followed: for example, the General Electric contracts at both Hanford and the Knolls Laboratory; the Carbide contract at Oak Ridge; the Du Pont contract for the Savannah River project; the University of California contract for Los Alamos; that of the University of Chicago for the Argonne laboratory, and numerous others. None of its major programmes were carried out by direct operation from the Commission itself. The U.S. authorities look to the use of the contract system as leading the way to the eventual termination of anything like a government monopoly in this field, and for the incorporation of atomic work into the normal competitive private enterprise system, which is regarded as the surest way of ensuring new and improved ways of doing things, and of achieving this result at the minimum cost.

As we announced in our columns last October, the U.S. Air Force has reported

the award of a contract for an air-frame to take a nuclear reactor. The contract is with the Consolidated Vultee Aircraft Corporation, the makers of the very large B.36 aircraft; the reactor is to be built by the gas turbine division of the American General Electric Company. More recently it has been decided to place a contract for a second with Messrs. Pratt and Whitney. It has been estimated that a B.36 bomber driven by nuclear energy would be able to fly 2 million miles on 1 lb weight of the fissile form of Uranium; but that hare has first to be caught!

Among other recent developments the Commission reports rapid expansion of the production plants for fissile materials. The U.235 diffusion plant at Oak Ridge has been considerably enlarged and will be supplemented by corresponding work at Paducah, Kentucky. A similar step is being taken to add to plutonium production at Hanford, with an addition at Aiken, S. Carolina. The experimental breeder reactor at Idaho was reported to have begun operation recently, with a power capacity of 100kW or thereabouts. Its estimated cost is about 3 million dollars. The cost of the reactor for testing structural materials is given as 18 million dollars, and submarine plant prototype 26 million dollars. The hope has even been expressed by a Senate Committee that an atomic-powered submarine may be available for testing within a year, though in a comment of wide general application appearing in the September issue of the *British Atomic Scientists' News*, it is explained, not inappositely, that "all scientists who need money from governments have to blow their own trumpets from time to time"! However, it certainly appears that progress is being steadily made. Various firms have been at work on appropriate nuclear power plants for a year or more. It appears that the U.S. Navy have a contract, with the Electric Boat Company of Groton, Conn., for the first nuclear power submarine, but it may be 1953 before there is much that can be claimed to be well on the way to completion.

The U.S. Atomic Energy Commission now has 5000 employees working under its immediate direction with perhaps so many as 75,000 more working under contract for universities and industrial firms. Its chairman takes a favourable view of the uranium sources available, for although no alternative deposit has been discovered which rivals that of the Belgian Congo, there have been other very promising developments in certain areas in U.S.A. and Canada in addition to the well-known possibilities in respect of the separation of uranium from gold mine residues in South Africa.

The Use of Atomic Energy as a Military Weapon

Much has been written—for and against—the use (and the effectiveness) of nuclear energy in warfare, but by far the most important contribution has been that from Mr. Churchill who has told us more than once that it was the existence of the large stockpile of atom bombs (and the means of delivering them) possessed by the United States that has given the Western Powers the much-needed breathing space in which to prepare their defences and so ensure that the "cold war" would be unlikely to become hot. Various estimates have been given of the probable size of the stockpiles now existing in U.S.A. and U.S.S.R.; they all agree in showing the U.S.A. to be very far ahead in quantity and, likely enough, in quality. The announcement from the White House in October of further atomic experimentation in the U.S.S.R. naturally excited some public interest, and this was enhanced by remarks made at about the same time by Mr. Gordon Dean: they bore the interpretation, which they were seemingly intended to do, that the U.S. authorities had discovered how to make smaller atom bombs than heretofore, and that in consequence atomic explosives could now be used tactically, and be thus employed in direct tactical reply to any army making an aggressive attack against a peaceful neighbour. Hitherto, the potential dictator had been chiefly held in check by the fear of an atom bomb reprisal attack on his cities—now, according to Mr. Dean, he can be more directly checked by powerful atomic weapons directed against his armies. To the peace-loving world this would be a very welcome gain. Mr. Dean added that if a situation should arise in which it seemed that the choice of any weapon is justified, serious consideration should be given to the atomic alternative, provided that it can be used effectively from the military standpoint—that is, that it should be no more destructive than is necessary to meet the particular situation. This may be put in few words, without much loss of intent, by saying that distinction between ordinary and atomic weapons is becoming very much less definite, and that accordingly there is a good argument for considering both kinds of weapon together in any scheme for a reduction in national armaments—subject, of course, to a really dependable check by impartial inspection. In a statement made subsequently in the British aeronautical press, Air Marshal Sir Robert Saundby raised the important question whether the availability of tactical atomic weapons might not mean that the day was past for great manpower armies; indeed, that the old-time threat of the "teeming horde" may become in these later days a decided "liability to its owners—a mere collection of human beings doomed to futility and death."

All this relates, of course, to the uranium bomb. Recent work has been directed also to the development of a thermo-nuclear bomb—known as the hydrogen bomb, or, more popularly, the "H-bomb." Whether this can actually be made has not been disclosed, but it seems, on the whole, to be likely that it can. If so, the power released by a single H-bomb may be as much as that of 1000 uranium bombs, just as the latter is 1000 times as powerful as one with T.N.T. as its explosive. In a book lately written by Laurence, an American writer and one of the Bikini observers, the author expects the H-bomb to make its experimental appearance in the near future. Since, as reported, each one must need a uranium bomb to act as its detonator, the importance of a large stockpile of the latter becomes increasingly evident, and so the present strength of the U.S.A. arsenal becomes potentially even greater.

The Eniwetok and Nevada Tests

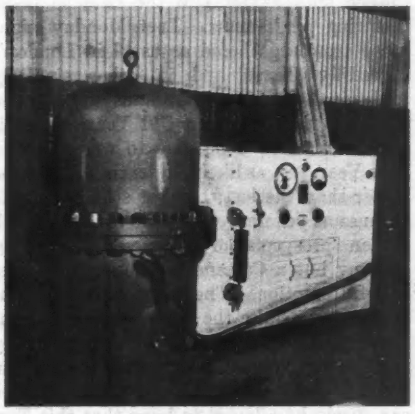
During the year further tests were made in the Eniwetok Proving Ground in the Marshall Islands and at the experimental proving ground in Nevada. The former began in April and part of the programme was completed by the end of the following month. Very little information has been released in either case as to the nature of the experiments or of the conclusions reached, but it is stated that the tests included detonations of sufficient energy to check previously made estimates as to the military effectiveness of certain weapons, some of which are claimed to be several times as powerful as those used over Japan during the war. It is added that information was also gained on the basic phenomena underlying thermo-nuclear reactions, such as would contribute to the design and production of the hydrogen bomb.

At the close of the year a further effort was initiated to find some accommodation between the major powers, such as might lead to an agreed method for the control of armaments, including those based on nuclear energy; but the prospect of a successful issue appears to be as slender as in the efforts made in previous years.

An Electrode Steam Boiler for Valve Testing

The illustration we reproduce below shows an interesting piece of equipment which was recently supplied by G.W.B. Electric Furnaces, Ltd., of Dudley, Worcs, to the A.B.C. Coupler and Engineering Company, Ltd., of Wolverhampton, for testing regulator valves for locomotives. The new equipment incorporates a 70kW electrode steam boiler capable of producing 235 lb of steam per hour at any required pressure up to 400 lb per square inch, and this pressure can be reached in the short period of eight minutes starting from cold. Prior to its introduction considerable time and labour was spent in obtaining the required pressure from a coal-fired boiler.

The equipment incorporates a built-in storage tank, feed pump and control gear, and is fitted with fully automatic load and pressure controls. As can be seen in the photograph, the steam raiser is coupled to a large pressure vessel, which is made in two sections. Valves for testing are fitted into the bottom section of the vessel and the top section is then bolted into position. Steam under the required pressure is then introduced on one side of the valve, which can be opened from the outside of the vessel to allow steam to pass from one section to the other. With this arrangement a valve can be tested for steam tightness and for all-round operation under working conditions. By means of the hand-lever-operated gear in the lower part of the pressure vessel steam can be released to atmosphere and subsequently closed to prove its steam tightness.



Electrode Boiler and Pressure Vessel

The compact design of the electrode boiler arranged adjoining the pressure vessel eliminates necessity for a boiler-house, fuel storage, &c., and minimises heat losses by convection and radiation as no long steam supply line is needed.

Structural Design Lectures at Sheffield.—A special post-graduate course of nine lectures entitled "The Design of Structures for Ultimate Strength" will be delivered at the University Buildings, George Street, Sheffield, at 7.30 p.m. on Thursday evening starting on January 17th. Each lecture will last about an hour with a further period for discussion. Admission to the course is free.

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A RETROSPECT

HOPE springs eternal in the human breast. It needs no more than some such trifle as the change of a numeral in the date to make it spring forth anew. Last Monday night great crowds gathered as usual in London's Piccadilly Circus and in other similarly traditional places in other lands and cities to celebrate the end of an Old Year, its trials and tribulations done, and to welcome in a New Year, just as likely, in truth, to prove no better than the last, but yet still New, still, because as yet unproved, able to glisten with golden prospects of improvement! Nor can any but a Cassandra be wholly free of hopeful emotion. The years flow on. But none is ever quite the same as any that has passed. Who knows what a New Year may bring us? No doubt it is true that "Man never is, but always to be blessed." But we can surely be allowed to hope that this New Year, one in which a new Government is in power, will shower some, even if only very few, blessings upon us!

It is, however, not our purpose here optimistically to view the future through rosy-tinted New Year spectacles. Rather it must be our purpose in this Retrospect soberly to rake over the ashes, still warm, of last year's fires, seeking to find therein some guidance as to what the present year may have in store for engineers. It is a task that sobers optimism. For 1951 seemed a year of retrogression. Twelve months ago as we looked back upon 1950 we were able to comment upon a happier state of affairs than had ruled in this country since the end of the war. For Britain's economy was flourishing. Thanks largely to the efforts of the engineering and allied industries, production during the year had continued rapidly to expand. Exports were finding ready markets abroad. Imports were increasing. The balance of trade had become unwontedly favourable. So prosperous had the country become that it had even proved possible to dispense with Marshall Aid. A year ago Britain seemed to have achieved national solvency at last. She was able, economically, to stand alone, asking no support out of the resources of other nations. Yet, even so, the shadow of the war in Korea lay over the second half of the year. Prosperous though Britain seemed, it could already be foreseen that harder times lay ahead. For the decision to rearm had been taken. Ever since the war the engineering and allied industries, by continuously expanding output, had proved to be the chief supporters of Britain's recovery. But in 1951 they would need to turn over substantial parts of their capacity to the manufacture of armaments. Once again engineers, men of peace who desire to use their beneficent talents to increase the material wealth of mankind, were to be called upon to divert their skills to the making of destructive rather than constructive things. Though war itself might thereby be averted, standards of living were likely to suffer.

REARMAMENT

But the prospects for 1951 did not seem so very black on New Year's Day of that year. It could, on that day, justifiably, still be estimated that the diversion of effort to the making of armaments might prove not so heavy as wholly to check the upsurge of prosperity felt in 1950. The industrial output of the country had been increasing year by year by some 8 per cent per annum. Were it to continue to do so, armaments might be produced in sufficient quantity to meet the programme and there might still remain some slight excess of output, which could grant the British people a small, but welcome, further improvement in living standards. The hope proved vain. As early as January revised estimates for defence raised planned expenditure from the £3400 million spread over three years, previously announced, to £4700 million spread over the same period. As much as £1300 million was to be spent in the financial year 1951–52. With that announcement there ended all hope that the defence programme could be carried through painlessly. Standards of living must suffer. The programme was no longer planned to be one that the country could bear easily. It was the largest the country could be expected to support without a return to full wartime controls.

THE OVERSEAS BALANCE

In the Economic Survey for 1951 it was estimated that as one of the consequences of raw material shortages and losses of production as factories were changed over and retooled for armaments production the national output in 1951 could not be expected to exceed that of 1950 by more than 4 per cent; that in fact, broadly, over the next twelve months there would be no net increase in rate of output over and above that ruling at the end of 1950. That prognostication turned out to be about true. In the first half of 1951 the monthly rates of production indices showed substantial advances above the corresponding figures for 1950. But the rate of production as the end of the year approached showed little advance on that ruling twelve months before. What the estimate failed to foresee was that imported raw materials would be not only scarce, but also very dear. Their cost was not forced up by any substantial increase in their usage throughout the world. For rates of production and therefore of absorption of raw materials cannot be suddenly increased by the announcement of great new programmes of defence expenditure. But all over the Western world—more particularly probably in the U.S.A.—Governments and individual firms continued to stockpile against future needs. At first the sterling area—though not the United Kingdom—benefited. But by the autumn a draft upon sterling area reserves began. Even in May Britain found itself paying as much as 42 per cent above the average price of the previous year for its imports at a time when export prices had risen only by 18 per cent; and though by the autumn the terms of trade had improved—import prices were 38 per cent up and export prices 24 per cent—this country was by then beginning to run a large deficit in overseas payments. As the year's end approached the United Kingdom was spending abroad at a rate of over £700 million a year more than it was earning. Early action could not be taken to correct the situation owing to the concentration of the country's attention upon the General Election in the autumn. But as soon as the Conservative Party found itself in power it took emergency action to restrict imports, lest the pound sterling were to have to suffer the indignity of yet another devaluation.

But as the year rolled on to its end it was obvious enough to everyone that the reduction in imports and the measures the new Government adopted to restrict the creation of credit could not by themselves wholly cure the nation's economic troubles. For it is not possible to divert a large proportion of a country's productive capacity to armaments production without producing certain internal effects. Men earn as much or more than before. Yet the amount of goods available to be bought must become less. Inflation threatens. Moreover—very unfortunately—in 1951 that policy of restraint in wage claims that trade union leaders had, since the round of wage increases granted soon after the war, persuaded their followers to accept, broke down. By the end of 1950 wage rates for all workers had risen

by only 14 points above the datum of 100 in June, 1947. But between December, 1950, and November, 1951, they rose by no less than another eleven points and the present round of wage advances was by no means ended as the bells rang the New Year in. What measures the Government will adopt in the present year to meet the all-too-obvious threat of a runaway inflation remain to be discovered. Will prices be allowed to rise in the hope (probably false) that renewed restraint in wage claims could be enforced? Will dependence be placed upon further fiscal measures to restrict the creation of credit? Is there any hope that Government expenditure can be so far reduced as to bring stability to the economy? Probably the Government will adopt an amalgam of such policies. Yet it is difficult to see how still further taxation is to be avoided.

Taxation and Depreciation

At the time of the General Election the Conservative Party declared that if it came into power it would not enforce dividend limitation, a policy decided upon by the Socialists, but would apply a new excess profits tax. Whether it still intends to do so is not clear. Certainly, unless such a tax could be strictly confined to those firms which may make unexpectedly large profits from defence orders the tax would be unpopular in industry. For, as the Federation of British Industries set out to prove in a pamphlet on *The Effects of Inflation on Industrial Capital Resources*, issued in November, there is good reason to believe that industry is already so heavily taxed that its capital resources are being depleted. From a factual study of the financial state of a rather small sample of eighty large, medium and small manufacturing firms the conclusions were drawn that the amount of undistributed profits put to reserve in the last few years has been inadequate to maintain industry's capital, and that the levels of profits have been "too low to sustain the burden of taxation under existing methods of computation and to maintain the productive capacity of industry." Indeed, to judge from the figures given in the pamphlet, firms have been forced to borrow money from the banks merely to maintain real capital intact, creating credit without any corresponding increase in real assets, an action that appears to be inflationary in itself. If further taxation is to be imposed industry will ask that it be linked at least to some alteration in methods of computation so that adequate provision can be made for depreciation.

Rearming the Services

That Britain, as one of the leaders of the Western nations, must rearm was accepted during 1951 by all parties in the State. For, deplorably, so divided is the world, war might break out at any time between Russia and the West. Moreover, of none of the three Services can it comfortably be said that plenty of modern equipment is available. In the past this nation has depended particularly upon the Navy as its sure shield and buckler. But it was forced to read in a White Paper issued by the Government in April: "The overall resources of the United States Navy are . . . far greater than our own and only by a large deployment of these resources can we hope to fight successfully another Battle of the Atlantic." Was it not a woeful confession for a Government to have to make about the Navy of the greatest shipbuilding nation in the world that it could not unaided protect this country's trade routes? What is now being done to build up more adequate anti-submarine forces is related elsewhere in this issue by our Naval Correspondent. About the equipment of our Army not much is known. We can but express the hope that progress is being made towards supplying our troops with tactical atomic weapons such as those which are now being developed in the U.S.A. For within a few years it will not be possible to claim any army modern that is without them. In the air Britain unquestionably has the best-designed aircraft in the world. But there are far too few of these up-to-date craft in service. Nor, since aircraft factories are short of manpower, were they produced rapidly enough during 1951.

Experience, twice this century, has emphasised the lesson that large stocks of equipment suffice only to fight short wars. Long wars are won far more by the rapid expansion of productive power after hostilities have started than by the weight of armaments available at their beginnings. Whilst rearming, therefore, in the hope thereby of deterring aggression this country needs also to study how armaments should be produced were war actually to break out. Upon that point Dr. Galloway, Director of the Production Engineering Research Association had some pertinent things to say during the year. In particular he stressed that "only by developing basic production techniques in advance of the needs of the armament factories is it possible to avoid the costly process of developing techniques by protracted trial and error on the production site, a process which not only gives rise to considerable waste of time, labour and materials, but which frequently fails to develop the best techniques." Towards the end of the year Mr. Churchill stated in the House that armaments expenditure had fallen behind programme. How much of the delay, we wonder, was due to just such causes as those mentioned by Dr. Galloway?

Productivity

Despite the fact that industrial output in 1951 was ruled rather by the availability of raw materials than by productive capacity, interest continued to be taken in raising output per man-year. For it is a truism that if the standard of living in this country is to rise output per man-year of its population must also rise. A further twenty-four reports on visits of teams to America under the ægis of the Anglo-American Productivity Council were issued, raising the total to forty-five. Like those published earlier, they varied widely in merit. Broadly it can be said that the value of the reports has proved more or less directly proportional to the degree to which production conditions here are comparable with those in America. Where the differences have been large the teams concerned have been hard put to it to write anything that is not common ground to all the reports. For instance, it did not need a visit of representatives of the N.C.B. to America to convince people here that coal-mining conditions there are so different from those ruling here that plant and methods are neither comparable nor interchangeable! Again, upon reading the report of the team of agriculturists we gained a very strong impression that a better purpose would have been served had an American team paid a visit to our intensively cultivated farmlands! Yet no visit by anyone across the Atlantic can be wholly valueless. Every team without exception has come back impressed by an atmosphere in the States favourable to increased productivity. Their members have attempted within their own industries to work up a similar enthusiasm here. Our impression is that they have encountered much frustration both from managements and from trade unions.

But is this individual approach the right one? Manufacture, surely, is a matter of economics. A manufacturer sets out to make his products, whether their quality be high or low, as cheaply as he can. It by no means necessarily follows that it will be cheapest to install machinery that will ensure high productivity per man-year. Nor does it necessarily follow, under present systems of taxation, that increase of output will be profitable. We feel, indeed, that not all the urgings of politicians, not all the reports of productivity teams, could do half as much to create conditions favourable to raising productivity here as the development of a more suitable economic atmosphere, one that gave to manufacturers and workers alike higher incentives to work harder, one harsh enough to make the worse managed firms fear for their livelihood and the less energetic workers fear for their employment, yet one not so harsh as to encourage trade unions and manufacturers to adopt self-protective restrictive practices. Perhaps the new Conservative Government will have the courage to attempt its creation. In the meanwhile it is worth noting that until raw material shortages intervened during 1951 the engineering industry was putting up by no means a bad performance in raising its output, despite controls, restrictions, regulations, and a whole gamut of frustrating circumstances.

Fuel, Power and Transport

Ever since the end of the war the Government has underestimated the power of this country's industries and particularly the engineering industries to increase their outputs year by year. As a consequence, capital has been expended at too low a rate upon the expansion of electric generating capacity, and upon increasing the output of coal, coke and gas; practically no capital has been spent upon the improvement of roads, already seriously overloaded with industrial traffic, and the railways have been able only so slowly to improve their services that it seems improbable their operation can become economic for years to come. Electric generating capacity at the end of 1951 was still some 3000MW below the peak harsh winter demand, and, far from being able to export substantial quantities of coal to markets in Europe that are crying out for it, the country was forced during the year to import 1·2 million tons of coal from America in order to meet home demands and minimum export commitments. No doubt it was in appreciation of the fact that, instead of improving, the situation is tending to deteriorate, that the Socialist Government formed in August the Power and Fuel Resources Committee under the chairmanship

of Viscount Ridley. That Committee is discussing measures "for the establishment of a national fuel policy for the efficient and economical use of all forms of fuel and power, particularly coal," and we think it will be encouraged to interpret those terms of reference widely, by the appointment within the Cabinet of Lord Leathers as a co-ordinating Minister for Fuel, Power and Transport. Industry will certainly look to the Committee to offer some recommendations towards the relief of short-term problems of fuel supply. But it will undoubtedly also consider longer term possibilities. Amongst the latter it will, no doubt, give thought to the possibility of conserving coal through electrification of the railways. For a committee appointed at the request of the Transport Commission by the Railway and London Transport Executives reported during the year that there was economic justification for the electrification of as much as 43·4 per cent of British railway tracks. No doubt that estimate would hold even if some system of electrification other than that preferred by the Committee were eventually to be chosen.

Iron and Steel

Amongst the shortages of materials that held back output in 1951 that of steel was unquestionably the most important. Yet, in fact, the output of the industry did not fall back far below that of 1950. As is mentioned in another article in this issue, final figures will probably show a production not far short of 16 million tons, compared with 16·3 million tons last year. But it was a difficult year for the industry. Supplies of scrap were hard to come by, and the import of ore was hampered in the early part of the year by the need to import coal from America. Stocks of materials ran low. Had coal output in this country been higher, had it been possible to export more to W. Europe, that is so short of it, a more adequate flow of scrap and ore might have been secured and the industry might have proved able to increase rather than reduce its output.

Moreover, on top of its troubles in obtaining raw materials the industry suffered from the obstinate determination of the Labour Government to bring into force the Iron and Steel Act at almost the earliest possible time permitted in the Act. The industry was nationalised in February of last year. But those who were leading the industry in its fight against nationalisation saw no reason to abandon the field when at any time within the next few months a new General Election might bring the Conservative party, pledged to repeal the Act, back into power. Since nationalisation the industry has had two heads—an Iron and Steel Corporation, with all the power, and the British Iron and Steel Federation, with the experience, and almost all the loyalty of the industry behind it. Co-operation between them proved far from complete. The Conservatives, now in power, have already stated that they will repeal the Act. But, so that the industry may be removed from the arena of party politics and its leaders be able to give the whole of their thoughts to its technical and industrial interests, it is much to be hoped that in repealing the Act the Conservatives will be able to find a means of bringing the industry under public supervision in some way which the Labour Party can feel itself able, if not openly, at least tacitly, to accept.

Education

During last year the discussion of technological education continued unabated; the protagonists of the setting up of technological "universities," of the creation of special technological colleges and of increasing the number of students at existing universities continued to expound their views. But had the Labour Government survived the matter might by now be regarded as settled. For in September, just before the date of the General Election was announced, a White Paper was issued reporting the Government's acceptance, with very slight modification, of the recommendations of the National Advisory Council on Education for Industry and Commerce that a "College of Technologists" should be set up to encourage the development in suitable technical colleges of advanced courses at "first award" and "post-graduate" levels, that increased financial assistance should be given to colleges and that new courses should be developed in close association with industry. "At the first stage, at any rate," it was not proposed under this White Paper (as it had been by the Council) that any responsibilities other than the granting of awards and the approval of courses should be laid upon the college. But with the coming of a new Government of a different political complexion it cannot be known whether that White Paper still represents accepted policy.

The Festival of Britain

The year that ended last Monday was "Festival of Britain" year. But, looking back at it, we feel tempted to exclaim "Festival Year, indeed!" For how could there be anything festive about a year in which so many scarcely soluble problems seemed to be gathering round to assault the State? Was it not paradoxical to celebrate the centenary of the Great Exhibition of 1851 which exalted the political power and supremacy of Britain, in a year when Persians stole the property of a British oil company, when, in the world's estimation the value of the pound sterling, already low, was falling lower, when we could neither make ends meet in oversea finance nor make as much progress in rearmament as we had planned, when we were forced to admit naval inability to protect our own trade routes without American assistance, when we could not produce enough coal, nor enough power, to meet our needs, when we had to import machine tools instead of producing them ourselves, to support our rearmament, and when monetary inflation grew and, as a consequence of a new and substantial round of wage claims, threatened to grow wholly out of hand? Yet the Festival *was* held. True, it was less significant to the world at large than the exhibition upon whose centenary it was held. True, there was something nostalgic about it, a looking back towards a departed greatness. Yet it revealed also an astonishing energy, a determination on the part of British people still to occupy a leading place amongst the peoples of the world, a belief that people here could and would present to the world a wealth of new discoveries to benefit mankind, and would not prove backward in industrial design. In this new "Age of Discovery," only to be compared for the intensity of its effects upon the human mind, and for its influence upon human riches, to the Renaissance, an age in which men dream of the "magic" things that the advancement of engineering and productivity may achieve, when the use of nuclear power, upon the vaster time scale of history, seems just around the corner; and when men may sanely calculate how they may journey to the moon and the planets, the Festival showed that Britain is still able to play a leading part. Monetarily it made a loss. There was much about it and about the exhibitions that formed such important parts of it that was open to criticism. It was unfortunate that it was held in such a year. In the excitement of a General Election and the coming into power of a new Government the British people has already almost forgotten it. But we do not think it was a failure.

Conclusion

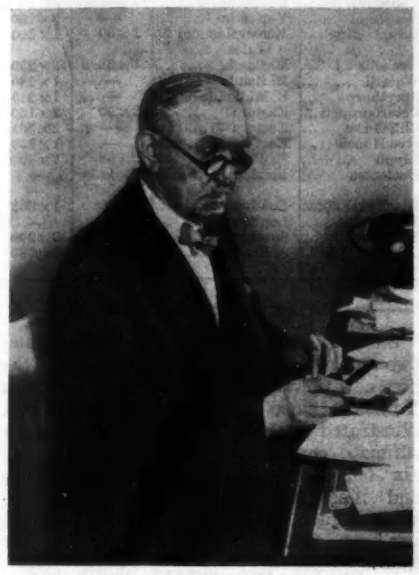
The urgent call to rearm influenced all the actions of Western nations in 1951 and coloured much of their thinking. But though the nations of the West saw rearmament as inevitable in the face of Russian armed strength, the nations of the Middle East and of S.E. Asia saw it rather differently. For them rearmament by the West necessarily means delay in carrying out the great and beneficent engineering and other schemes planned for their areas. That delay may prove dangerous. For if standards of living there are to rise, as their peoples demand, engineering development must take place fast enough to outbalance the demands of rapidly expanding populations. Nor is the possibility of tragedy, if the delay is too prolonged, confined to those areas. Without engineering development there the food supplies of the world may run short and the West—more particularly Europe—suffer as severely as the East. Moreover, it must be to the ultimate benefit of the West to raise standards of living in undeveloped countries. For thereby immense markets for Western products would be created. To engineers, in fact, aware how great are the material benefits they can confer by their works upon the world under such schemes as those envisaged under the Colombo plan, it is tragic that the main producing nations of the earth should be devoting as much as 15 per cent of their productive energies to the making of armaments that serve to lower rather than raise man's living standards. For ourselves, we wish we could believe, as this New Year begins, that international tension will ease in 1952. But we cannot. There is no blessing upon international negotiations in which each side distrusts the other's intentions and questions its sincerity! In 1952 engineers will be forced to continue to produce arms. They will take a deep interest in the technical problems involved, and they will learn from the experience lessons that can be applied in civilian production. But they could, were only statesmen able to ease international tension, far better benefit the world by concentrating their energies upon their true task, never better defined than in the Charter of the Institution of Civil Engineers, "of directing the great sources of power in Nature for the use and convenience of man."

Obituary

CLARY EDGAR ALLEN

It is with deep regret that we have to announce the death of Mr. Clary Edgar Allen, which occurred at his home in New Romney on Monday, December 24th, barely nine months after his resignation as a director of the Machinery Publishing Company, Ltd., and editor of our contemporary, *Machinery*. It will be remembered that Mr. Allen had to retire owing to ill-health, although he continued to act as consulting editor up to the time of his death.

Mr. Allen was born at Nottingham on November 21, 1871, and after a private education he studied mechanical engineering at King's College, London, and electrical engineering at the Northampton Polytechnic Institute and Birkbeck College, London. Following practical industrial experience in the works of Manning, Wardle and Co. and Marshall, Sons and Co., Ltd., he began his career as a journalist as acting editor of *Fielden's Magazine* in 1898. When that journal later became *The Engineering Review* he was appointed editor and director. During this period he also acted as a consulting engineer for machine shop equipment and power plant, and he played an important part in the organisation of the Machine Tool Exhibitions at Manchester in 1910 and in London in 1912.



C. Edgar Allen

In August, 1912, Mr. Allen was appointed editor of *Machinery*, publication of which was started in the October of that year. From that time he occupied prominent positions in both the machine tool and allied industries, and became a familiar and popular figure amongst technical journalists. He travelled widely at home and overseas, and for many years attended practically every important exhibition connected with the use or manufacture of machine tools in this country, Europe and America. A typical instance of his thoroughness and tireless energy was in 1931, when, appreciating the importance of Russia as a potential market for machine tools, he made an extensive tour of investigation of that country. Following the visit he wrote an authentic first-hand account of his findings, which was widely read and aroused much interest in this country.

Mr. Allen, who was appointed to the board of directors of the Machinery Publishing Company, Ltd., in 1927, was an associate member of the Institution of Mechanical Engineers and of the Institution of Electrical Engineers.

Clary Allen, as he was familiarly known, with his many gifts, was essentially a simple man with an abundant measure of good fellowship, which made him both respected and liked by all who were fortunate enough to meet him. His death is a loss which will be felt by his wide circle of friends in the machine tool industry and technical journalism.

ENGINEER REAR-ADMIRAL JAMES ASHTON

We have noted with regret the death of Engineer Rear-Admiral James Ashton, D.S.O., which occurred at New Milton, Hants, on Sunday last, December 30th. Rear-Admiral Ashton, who was sixty-eight, was formerly chief engineer at Bermuda Dockyard, from which appointment he retired in 1936.

Rear-Admiral Ashton was born at Huntingdon and was educated at Bedford Grammar School and the Royal Naval Engineering College, Devonport. In the first world war he served as an engineer officer in the destroyers "Murray" and "Taurus," and was awarded the D.S.O. in 1918. Subsequently, after promotion to the rank of Engineer-Commander, Ashton served in the flotilla leader "Mackay." In 1923 he was appointed to the staff of the Royal Naval Engineering College, Keyham, where he remained for three years, prior to appointment to the battle cruiser "Renown." Ashton succeeded Engineer Captain C. E. Sutton as chief engineer of Bermuda Dockyard in 1934, and continued in that appointment for two years, when he retired with the rank of Engineer Rear-Admiral. On the outbreak of the second world war, however, he returned to duty and served at the Admiralty from 1939 to 1945.

ARTHUR POLLITT

We regret to record the death on December 23rd, after a short illness, of Mr. Arthur Pollitt, who was deputy controller of the London Division of the British Electricity Authority.

Arthur Pollitt was born at Winton, Lancashire, on March 21, 1891. He was educated at Salford Grammar School and at the Royal Technical College, Salford. His engineering career began in 1906 with a five-year apprenticeship with Browett Lindley and Co., Ltd., Manchester. In 1912 he joined Hick, Hargreaves and Co., Ltd., as a junior engineer and specialised in high-speed engines. From 1912 to 1913 he spent short periods at sea before taking an appointment as contracts and constructional engineer with the Brush Electrical Engineering Company, Ltd., Loughborough, where he stayed until 1919, specialising in diesel engines.

His direct association with the electricity supply industry began in 1919, when he joined the Manchester Corporation Electricity Department as assistant chief constructional engineer. In 1927 he left to take up a similar appointment with the London Power Company, Ltd., and, in 1933, he was promoted to the post of chief constructional engineer, taking charge of all the company's constructional activities from the design stage to testing and commissioning. In 1948, during the early stages of the reorganisation of the supply industry, he joined the London Division of the B.E.A. as chief generation engineer (construction). He was appointed deputy controller of the London Division in October, 1950.

During his career Arthur Pollitt presented papers on boilers and turbo-alternators, and he was responsible, in association with the late Sir Leonard Pearce, for carrying out researches on flue gas washing. He was a Constantine Gold Medallist—an award that was made for his paper, "Developments in Design of Boilers and Boiler-House Auxiliaries." His outlook was, however, essentially that of a practical man, and he had decided views on the subject of generation. Thus, he never allowed himself to forget that the primary purpose of a power station was to generate electricity cheaply and efficiently, and that expensive refinements, such as gas washing, could not be indulged in without increasing the costs of generation—costs that meant the expenditure of scarce raw materials and valuable man-hours.

Mr. Pollitt was a member of the Institution of Mechanical Engineers, a member of the Institute of Marine Engineers, and an associate member of the Institution of Electrical Engineers. He was also a Freeman of the City of London and a member of the Court of Assistants of the Worshipful Company of Horners.

G. A. JUHLIN

As this issue goes to press, we learn with deep regret of the death of Mr. Gustaf Adolf Juhlin, which occurred at "The Grange," Goostrey, Cheshire, on Monday last, December 31st. Mr. Juhlin, who was seventy-one, was, until his retirement in 1947, a director and the chief electrical engineer of Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

COMPOUND LOCOMOTIVES

Sir,—In answer to Mr. W. B. Thompson's letter, appearing in The Engineer of December 7th, I am afraid I am unable to give the information required relative to the genesis of the particular compound system we ascribe to W. M. Smith of Gateshead.

The reference made by Mr. Thompson to the early French three-cylinder compound is most interesting and raises the question as to whether F. W. Webb had any knowledge of this compound cylinder arrangement because, according to Ahrons, an engine with one h.p. and two l.p. cylinders was contemplated by Webb at one time, only to be put aside for the same arrangement in reverse, i.e., two h.p. and one l.p.

E. C. Poultney

London, N.W.3, December 27, 1951.

BOOKS RECEIVED

Mathematical Solution of Engineering Problems. By J. Jennings. London: E. and F. N. Spon, Ltd., 15, Bedford Street, Strand, W.C.2. Price 25s.

Stainless Iron and Steel. Vol. I. By J. H. G. Monypenny. Third edition. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 45s.

Cutting Tool Materials. By Eric N. Simons. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 21s.

Radio Installations: Their Design and Maintenance. By W. E. Pannett. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 45s.

Proceedings of the Fourth Empire Mining and Metallurgical Congress. Parts I and II. London: Fourth Empire Mining and Metallurgical Congress, Great Britain, 436, Salisbury House, Finsbury Circus, E.C.2. Price 40s. (Parts may be purchased separately at 20s.)

Electrical Engineering in 1951

No. I

Electricity Generation

THE achievements of the British electricity supply industry in 1951 can be briefly summarised by saying that, in spite of some disappointments in the installation and commissioning of new plant and in spite of the deliberate restrictions imposed on the natural development of electricity sales there was a substantial increase in the number of units generated. This increase under the prevailing conditions reflects particular credit on the operations engineers, and there are probably few people outside the supply industry who are in a position to appreciate the difficulties of grid system operation at times when, despite load shedding, generation and transmission capacities approach the safe limit.

A small part of the story is told in figures taken from the third annual report of the British Electricity Authority from which we learn that the total quantity of electricity sent out from B.E.A. steam power stations in the year ended March 31, 1951, was 51,808 million units, or 13·3 per cent more than in the previous year.* On the other hand, the output capacity with all plant in service was 13,156MW at March 31, 1951, only 6·6 per cent more than the year before. A clearer picture of the present position is obtained from a study of the growth in the peak demand during recent years. According to B.E.A. records the estimated potential demand has risen from 10,537MW in 1948–49 to 12,282MW in 1949–50, and 13,448MW in 1950–51. The corresponding figures for the total output of the Authority's power stations at time of maximum demand were 10,106MW, 10,764MW and 11,229MW. It follows that the estimated load reduction caused by load shedding has increased sharply from 521MW in 1948–49 to 1518MW in 1949, and 2219MW in 1950–51. These figures, which give a rough measure of the plant deficiency without allowing for any reserve capacity, leave no room for complacency. They show why the B.E.A. is, and must continue to be, gravely concerned over the means of achieving existing plant construction programmes and the need for framing realistic programmes for the future.

Apart from the need for avoiding load shedding there is at least one urgent reason for installing new plant at an increasing rate. The matter was discussed by Sir John Hacking when he pointed out, in his presidential address to the Institution of Electrical Engineers, that the necessity for retaining old plant in service beyond its useful life lowers the average B.E.A. overall thermal efficiency of power stations. For example, one quarter of the total output in the year ended March 31, 1948, was generated by plant with an average thermal efficiency as low as 16·3 per cent. Sir John quoted an estimate that if it had been possible to commission new plant according to programme and to meet demands in full, the utilisation of lower efficiency plant would have been much reduced, and the average thermal efficiency would have been increased from 21·5 per cent to 22·5 per cent, with a saving of 1½ million tons of coal in the year! Further, if 1000MW of new plant could have been installed to replace old plant of low efficiency, the average thermal efficiency would have been raised to 23·0 per cent with an additional annual saving of about 800,000 tons of coal.

*The corresponding figures for the first 50 weeks of 1950 and 1951 were 49,006 and 53,799 units.

Another important aspect of the enforced retention of time-expired plant is its effect on the reduction of generating capacity due to breakdowns. This figure rose from 6·0 per cent in January, 1950, to 7·2 per cent in January, 1951. Whilst teething troubles with new plant may have contributed to the loss of generating capacity, a major factor must be the use of old plant, and the increased loss is disquieting.

Some trends in electricity generation in Great Britain were discussed in Sir John Hacking's I.E.E. presidential address, to which we have already referred briefly. To show the effect of the size of generating plant he pointed out that in 1929 a total installation of 759MW required fifty-four turbo-alternators and ninety-nine boilers; with its larger plant units, the 1950 installation of 1034MW required only twenty-three generating sets and forty-five boilers. Boiler units of increased capacity became a practical proposition when several fusion welding plants of increased size were installed together with the associated heavy plate bending presses. With larger boiler units it is possible to adopt the favoured unit lay-out of one boiler per set for sizes up to 60MW and eventually up to 100MW. Accordingly, more than a third of the total plant programme of 13,000MW will have unit boiler lay-out; the total of ninety-seven individual boilers and sets will include fifty of 60MW capacity and five of 100MW.

Turning to steam cycle developments, Sir John showed how the reheat cycle, which originated in Great Britain, had been neglected there (although widely used in the U.S.A.) because of difficulties associated with the use of inferior coal. He went on to mention recent work which showed that by locating the primary superheater in the radiant-heat zone, or by using tilting pulverised fuel burners, better control of steam temperatures could be achieved, making unit boilers practicable for 100MW sets, using reheat. From the B.E.A. annual report we learn that the reheat cycle will be used in the new station at Ferrybridge, where it will be applied to larger units and higher steam conditions than in previous reheat installations in this country. Although the exact steam conditions remain to be settled it is intended that temperatures should be limited to 1000 deg. Fah. so that ferritic alloys may be used freely in the boiler.

Generation Plant Construction

At a B.E.A. conference in June last, Lord Citrine, chairman of the Authority, outlined some of the difficulties encountered in installing new plant at the rate required. He pointed out that the aim was to commission at least 1000MW—possibly 1250MW—in 1951. Programmes for subsequent years were based on the contention that it was necessary and practicable to reach an annual total of 1800MW in 1956, but it was clear that the attainment of this goal would be jeopardised by the repercussions of the rearmament programme and by the Government's decision to limit generating plant construction to a maximum of 1500MW in any year.

Shortage of steel remained one of the main problems, but the supply of other raw materials, such as copper, zinc, nickel and molybdenum was far from satisfactory. Summarising his review of the position in June, Lord Citrine thought that, unless there was a decided improvement, it might not be feasible to commission as much plant in 1951 as in 1950. In the event, however, the rate of commissioning towards the end of 1951 appears to have exceeded the more conservative expectations and, at the time of writing, the total figure realised for the year is likely to be about 1000MW.

Details of the newly commissioned plant as at December 1st are given in the accompanying table, and brief reference to some of the stations is made in the succeeding paragraphs:—

New Generating Plant Commissioned by B.E.A.

Power Station	Generating Division	Sets, MW.I.	Boilers, k-lb per hour
Portobello	S.E. Scotland ...	1×60	—
Clyde's Mill ...	S.W. Scotland ...	1×30	2×180
Brachead ...	S.W. Scotland ...	1×50	2×300
Agecroft	N. Western... ...	—	1×315
Westwood ...	N. Western... ...	1×30	1×300
Skelton Grange	Yorkshire	2×60	2×360
Thornhill... ...	Yorkshire	—	3×200
Neepsend ...	Yorkshire	—	2×190
Bromborough...	Merseyside and N. Wales	1×50	1×300
Nechells	Midlands	1×52·5	2×230
Walsall	Midlands	—	1×180
Staythorpe ...	E. Midlands ...	—	1×240
Peterborough...	Eastern	2×20	2×160
Cliff Quay ...	Eastern	—	2×365
Rye House ...	Eastern	—	1×350
Llynfi	S. Wales	2×30	1×300
Battersea ...	London	2×1·35 1×6·0	—
Blackwall Point	London	1×30	1×365
Fulham	London	1×60	—
Poole	Southern	1×50	3×300
Croydon "B"	S. Eastern	1×52·5	2×320

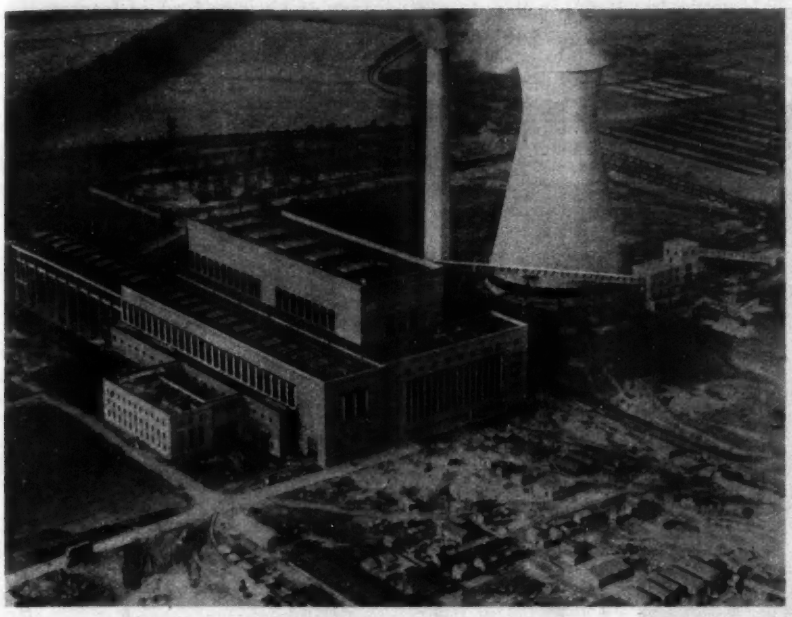
Skelton Grange

Skelton Grange, with two 60MW sets and two 360k-lb boilers in commission, is the first new power station to go into service in Yorkshire since vesting day. The station (illustrated on page 25) is designed for an ultimate capacity of 360MW, made up of six 60MW hydrogen-cooled Parsons sets and nine International Combustion pulverised fuel fired boilers—six of 360k-lb per hour capacity and three of 550k-lb per hour.

The power station site, which is at Knostrop, near the Leeds Corporation sewage disposal works, has many natural advantages; it includes a large area of land, above flood level, near the River Aire, with reasonable cooling water facilities, good access by road, rail and canal, proximity to coalfields and to a load centre made up of domestic and industrial consumers.

Among the interesting points about Skelton Grange power station is the circulating water system. In the first place, water is pumped to the condensers through a bus main along the length of the turbine house. Secondly, all the sewage effluent from Leeds is pumped to the station and use is made of water recirculated through 36 acres of sewage beds. Recirculation is also used to supplement the river flow by pumping water from a point 1½ miles downstream from the circulating water outlet; the river water is pumped into the nearby Calder canal and flows over a spillway discharging into the river above the circulating water inlet. In effect, a considerable quantity of water is impounded. With these arrangements the number of cooling towers required for operating the complete station will be limited to two, and it is anticipated that they will be called into use only when the river fall is below its normal level.

Coal is delivered mainly by rail, but a substantial contribution is made by canal-borne supplies from the conveniently situated West Riding pits. There is a direct connection between the station rail sidings and the



SKELTON GRANGE POWER STATION

private railway system of the nearby Waterloo Colliery. Provision is also made for fuel to be supplied by road from the Rothwell pit, 1½ miles away.

The p.f. fired furnaces have corner-mounted tilting burners, giving automatic temperature control. Before emission from the 375ft reinforced concrete chimney, the flue gases pass through electrostatic precipitators. Steam conditions at the turbine stop valve are 900 lb per square inch and 925 deg. Fah. A final feed temperature of 385 deg. Fah. is obtained with five stages of feed heating. Power is generated at 11kV, which is stepped up, by direct-connected transformers, to 132kV, and switching takes place at that voltage in the nearby grid substation, which is controlled from the power station control room.

The whole project was designed and developed by Leeds Corporation Electricity Department, the consultants being Messrs. Merz and McLellan, assisted by Sir Alexander Gibb and Partners on the engineering side. Formal consent for the power station was given in October, 1946, and, after site clearing, constructional work began in July, 1947. The first set went on commercial load on May 16th last, and the second set was commissioned in November.

Westwood

Another new power station commissioned this year is Westwood, which stands on the site of the old Westwood Park, Wigan, and comes within the North-Western Division of the B.E.A. Westwood is well sited for receiving fuel from the Lancashire coalfields, and there is provision for coal to be transported to the station by rail, canal and road. In the absence of natural circulating water facilities the needs of the station will be supplied by two 300ft cooling towers, each having a capacity of 3 million gallons per hour.

Ultimately the installed capacity of this station will be 120MW, provided by four B.T.H. 30MW, 11kV, turbo-alternators designed for stop valve steam conditions of 600 lb per square inch at 850 deg. Fah., and four-stage feed heating to give a feed temperature of 325 deg. Fah. A general view of the turbine house as it appeared recently is reproduced in Plate 5.

Steam is generated by Babcock and Wilcox pulverised fuel fired boilers, of which there will eventually be five, each with a capacity of 300k-lb per hour. Ash will be disposed of by filling in the nearby Westwood Flash, which will make available to Wigan a large and valuable stretch of land near the centre of the town.

The first boiler installation was completed in August, 1951, and the first 30MW generating set was in commission a month later.

The consulting engineers for Westwood power station are Messrs. Kennedy & Donkin, in association with Messrs. C. S. Allott and Son for the civil engineering works.

Braehead

Braehead, another new station, illustrated herewith, is in the S.W. Scotland Division, and is built on the south bank of the River Clyde about 4 miles downstream from the centre of Glasgow. The 20-acre site is well favoured in that it is in the heart of an industrial load centre and enjoys good facilities for river cooling water, rail and water-borne coal supplies and for disposal of ash at sea.

The station will have an ultimate plant capacity of 200MW, which will be made up of four 50MW Parsons turbo-alternators taking steam at 900 lb per square inch and 900 deg. Fah. from eight Babcock and Wilcox pulverised fuel fired boilers, each with a capacity of 300k-lb per hour and an economical rating of 240k-lb per hour. Fuel is fed to the boilers on the unit system, with firing by six burners per boiler, each having three ports in the front wall of the furnace. Combustion is supervised by unified boiler control from a central position in the boiler-house. Ash (30 per cent) is collected in hoppers and disposed of by high-pressure sluicing. Dust is extracted from the flue gases in electrostatic precipitators, collected in hoppers and removed by a vacuum system, the gases being discharged by a single chimney (with a restricted height of 256ft) at the eastern end of the site.

Each of the three-cylinder turbines incorporates five-stage feed heating, giving a feed water temperature of 390 deg. Fah., and a closed feed drain cooler. The alternators generate at 11kV running at 3000 r.p.m. and the voltage is stepped up by generator transformers to 132kV. An interesting detail is the adoption of indoor switching; the 132kV low-oil-content switchgear was supplied by A. Reyrolle and Co., Ltd. All main switchgear generators and key auxiliary supply circuits are controlled from the power station operations room.

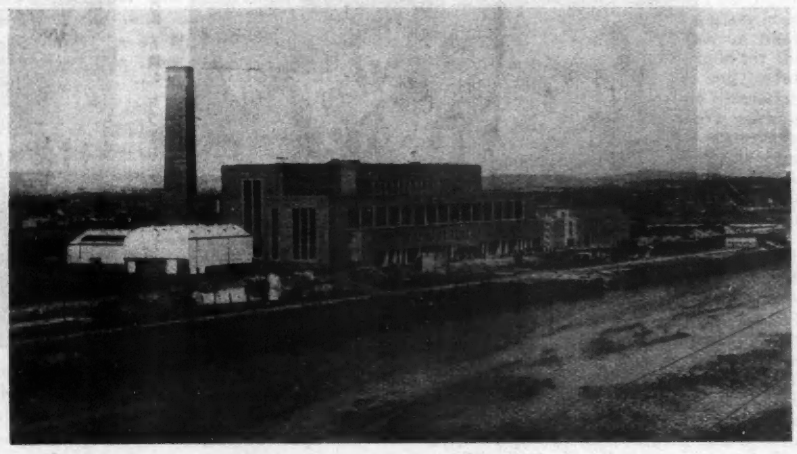
Two of the 300k-lb boilers were installed during the year under review and the first generating set was commissioned in August.

The consulting engineers for Braehead power station are Messrs. Merz and McLellan, in association with Sir Alexander Gibb and Partners for the civil engineering work.

Nechells "B"

One of the illustrations on the next page shows a general view of the turbine house of the new Nechells "B" power station, which is on a site adjoining the existing "A" station and is designed for an ultimate installed capacity of 210MW. Circulating water for this output capacity will be taken from the nearby Birmingham and Warwick canal and the River Tame, to supply three reinforced concrete cooling towers, each having a capacity of 4 million gallons per hour.

Steam is generated by International Combustion stoker-fired boilers, of which there will eventually be twelve, each with a maximum continuous rating of 230k-lb per hour. The boilers are arranged back to back in two rows separated by the fan bay, housing the forced and induced draught fans. The steam generating plant is designed for the combustion of low-grade coal and up to 20 per cent coke dust from the nearby gasworks. Fuel handling arrangements allow for the coal and coke delivered to the station by



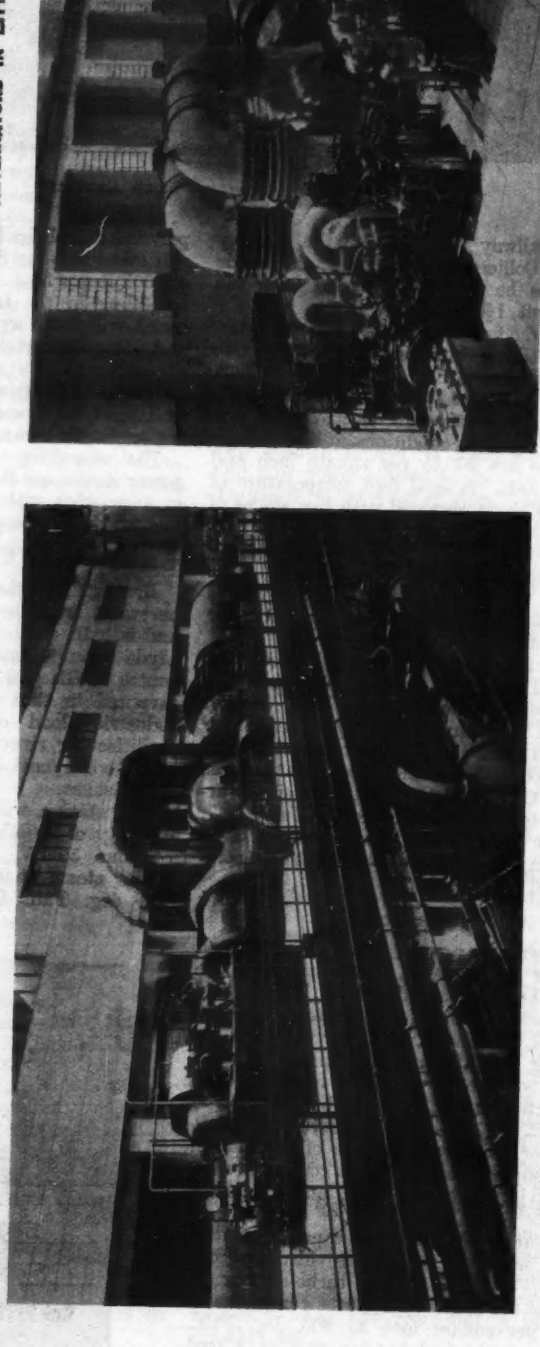
BRAEHEAD POWER STATION

TURBINE ROOMS OF B.E.A. POWER STATIONS

TWO 60MW TURBO-ALTERNATORS IN LITTLEBROOK "B" POWER STATION

FOUR 52·5MW TURBO-ALTERNATORS IN CROYDON "B" POWER STATION

NECHELLS "B" POWER STATION TURBINE HOUSE



60MW TURBO-ALTERNATOR IN BATTERSEA "B" POWER STATION

rail, road or canal to be discharged to the boiler-house bunkers, or to the coal store, whence it can be reclaimed, as required, for delivery to the bunkers.

When the station is fully developed it will house four 52·5MW, 3000 r.p.m. Parsons sets generating at 11kV, the steam conditions being 650 lb per square inch at 825 deg. Fah. The first of these sets was commissioned in June, 1951. Nechells "B" power station, which is in the Midlands Division of the B.E.A., was initiated by the City of Birmingham Electricity Supply Department.

Blackwall Point

In the London Division a new power station, Blackwall Point, came into commission during the year under review. It is built on the south bank of the Thames, in River Way, Greenwich, and supersedes the old power station, which was established in 1900 by the South Metropolitan Light and Power Company, Ltd., and which stopped generating on March 31, 1947, when it was working as a single-shift station with a peak output of 15MW. Shortly afterwards, the old station was demolished to make way for its successor, which is designed to house three 30MW, 11kV English Electric turbo-alternators and three 365 k-lb per hour Babcock and Wilcox p.f. fired boilers with steam conditions at the boiler stop valve of 635 lb per square inch and 875 deg. Fah. Three-stage feed heating raises the feed water temperature to 340 deg. Fah.

Rebuilding of the station was simplified by acquiring a site on the opposite side of River Way; there it was possible to build new substations prior to demolishing the substation buildings on the existing site. They consisted of a 2·75kV, two-phase distribution sybstation and a new 33kV substation. The second of these buildings was also designed to accommodate the generator transformers as well as the feeder reactors and substation transformers. Above the new switch houses are the control room and offices, with a footbridge over River Way giving access to the power station.

An island jetty has been built to accommodate sea-going colliers with a capacity (limited by the width of the river frontage) to 3000 tons. Between the river bank and the power station buildings there is a coal store with a capacity of 5000 tons. Ash is handled by high-pressure sluicing, and dust by a vacuum system, to ash and dust bunkers at one end of the coal store, whence disposal is effected by belt conveyors discharging to an ash barge loader on the inner face of the island jetty. Circulating water is taken from the Thames through an inlet tunnel to pump and screen chambers built in a corner of the turbine house; it is discharged through a single tunnel with its outlet below a dolphin near the end of the coaling jetty.

The first turbo-alternator and the associated boiler were commissioned in June, 1951.

The consulting engineers for Blackwall Point power station are Messrs. Merz and McLellan, in association with Sir Alexander Gibb and Partners on the civil engineering side.

Other Installations

To close this part of our review we propose to refer briefly to some of the more interesting generating sets which have been installed during 1951 and are, at the time of writing, approaching their commissioning.

One of our illustrations (page 26) shows the turbine house at Littlebrook "B" power station, where the second of the 60MW hydrogen-cooled Metropolitan-Vickers sets is now installed. Both the 3000 r.p.m. turbines are three-cylinder units with steam inlet conditions of 1200 lb per square inch at 825 deg. Fah., the main point of interest being the use of reheat to 825 deg. Fah. between the h.p. and i.p. cylinders.

Each machine has twin steam chests and each chest contains three governor valves and an emergency valve. The governor valves operate in parallel; the first pair deal with loads up to 48MW and the first and second pairs together with loads up to the economical load of 54MW. The third pair are by-pass valves which by-pass steam from immediately after the velocity wheel and re-admit it after the sixth stage; to attain the maximum load of 60MW all six valves are opened fully.

The control of steam admission is effected by an oil relay system in which a primary auxiliary oil relay valve, actuated by a centrifugal speed governor, controls the movement of a main relay valve which, in turn, regulates the admission of oil to the main power piston operating the governor valves. This primary relay serves as a preliminary force-magnifying device and relieves the governor of all but the very smallest loading, which results in very sensitive governor control.

The quantity of steam in the reheater and interconnecting pipework is beyond the control of the main speed governor, and, to ensure that in the event of loss of load this steam does not cause undue speed rise, an interceptor governor and twin intercepter chests, containing emergency valves and interceptor valves, are supplied. The method of operation of this interceptor governor is similar to that of the main speed governor. Through the medium of relay pressure oil the interceptor governor determines the opening and closing of the two interceptor valves, thus controlling the quantity of reheated steam passing to the intermediate cylinder.

The hydrogen-cooled generators were described in The Engineer, June 11, 1948, page 565. Four hydrogen coolers, fitted with plain finned tubes, are situated around the periphery of the stator yoke; this arrangement enables the coolers and generator to be incorporated in a single gas-tight casing and reduces the risk of leakage in the cooling system. The alternator output is generated at 11·8kV and the exciters are separately driven.

Another illustration on page 26 shows the 60MW hydrogen-cooled Metropolitan-Vickers set recently installed in Battersea power station. The inlet steam conditions are 1350 lb per square inch at 950 deg. Fah., and the 3000 r.p.m., three-cylinder turbine is so designed that the maximum rating of 60MW is also the economical rating. Hydrogen cooling is by the same system as was developed for the Littlebrook sets described above.

Progress at Croydon "B" power station (The Engineer, January 14, 1949, page 43) is indicated by one of the illustrations on page 26, which shows four 52·5MW Metropolitan-Vickers sets; the third set was commissioned in August, 1951, and the fourth set is under erection. The turbines are two-cylinder units designed for inlet steam conditions of 600 lb per square inch at 850 deg. Fah.

Agecroft power station (illustrated in Plate 5) is equipped with turbines of exactly the same design as those at Croydon, but the alternators generate their output at 33kV and, as transmission is at the same voltage, no step-up transformer is required.

(To be continued)

South African Engineering News

(From our South African Correspondent)

Road Developments in the Union

It has been decided by the Department of Transport, acting on recommendations made by the Roads Commission, to spend £90,000,000 on South African highways by 1960, this sum to include all items such as interest on loans and maintenance costs. The cost of building roads in the Orange Free State, where the country is very flat, and construction therefore very much easier, has been estimated at about £8000 to £10,000 per mile. In Natal, however, the cost of some stretches in hilly country worked out to about £23,000 per mile.

National roads at the present time are being built at an average of 200 miles per year. At the end of March, 1950, 2250 miles had been completed and 1530 miles completed to gravel road standard. The total expenditure each year on urban and rural roads and streets was about £20,000,000. Of this, about £15,000,000 was spent on the improvement and maintenance of rural roads and about £5,000,000 on urban roads and streets. The annual expenditure represented about 2 per cent of the national income. It has been stated that, as far as is known, this percentage has never been exceeded even in America, where roads are more highly developed than anywhere else in the world. The total revenue derived from motor vehicle users and from import duties on vehicles and spares amounted to about £15,000,000 a year.

In particular, a fifteen-year road construction programme for the Free State, estimated to cost over £19,000,000, has been announced. This programme envisages the construction of two special national roads, from Bothaville to Maseru and from Kroonstad to Newcastle, in Natal. This programme includes 842 miles of provincial tarred roads at a cost of £4,631,000, the maintenance and improvement of 5000 miles of existing roads at a cost, over fifteen years, of £1,500,000; 1106 miles of special high-grade gravel roads, at a cost of £1,659,000; the construction of modern bridges with double traffic lanes, at a cost of £700,000; and the expenditure of £9,750,000 over fifteen years on road-building equipment.

A Large Stoker Constructed at Port Elizabeth

A very large "L" type Louvre travelling grate stoker has been built in the Port Elizabeth factory of International Combustion, Africa, Ltd. Completed in June last, this stoker, which will be installed in the Electricity Supply Commission's new power station at Vierfontein, weighs 280 tons. With a grate area of 825 square feet and a 6in depth of coal bed, the machine can burn 6½ tons of coal per hour.

The manufacture of stokers of this kind forms part of an extensive production programme covering power station boiler plant and ancillary equipment, on which the Port Elizabeth works of International Combustion is at present engaged. The company has on hand orders totalling several million pounds for the Electricity Supply Commission and other bodies throughout the Union and the Rhodesias.

The largest order on which it is now working involves the production of twelve water-tube boilers complete with underfeed "L" type Louvre stokers. Each boiler has a rated capacity of 210,000 lb of steam per hour. The underfeed stokers, as described above, are the first of their kind to be built in South Africa

These twelve boiler units and stokers are all to be installed at Vierfontein. They will provide steam for the power station's turbo-alternators, which in turn will generate the large amount of electricity required for the rapid development of the Free State goldfields. The contract works are scheduled for completion in 1954. When operating at its full designed capacity the Vierfontein power station will be the largest in the southern hemisphere. Seven 130MW turbo-alternators are to be installed.

Aeronautics in 1951

No. I

LORD BRABAZON OF TARA, whilst proposing a toast at this year's Anglo-American Aeronautical Conference, suggested that the charm of aeronautics was its restlessness; that it never remained static for five minutes, but was always changing.

True it is that last year must ever testify to the recent restlessness of the aeronautical sciences! The vast research, wind tunnel and experimental flying programmes of the post-war years, which stage by stage had been made manifest on many prototypes, have now transformed the whole profile of flying machines. This is particularly true of the military aircraft, types of which, officially regarded as superior to any in the world, were this year at last placed in production in this country. It would be folly to suppose that this transformation is by any means complete.

Mention has already been made of the superiority of this country's latest military production aircraft; reference must also be made of its established lead in the development of aeronautical gas turbines, from which the unique position held by British gas turbine civil transports has largely derived. It is not difficult to confirm the lead in this sphere of gas-turbined transport aircraft, for it is admitted in a recent report by the United States Aeronautic Administration Prototype Advisory Committee. In that report it is stated this country has a lead from "three to five years" with such aircraft, on which it had logged 2800 flying hours. Of this total the "Comet" and the "Viscount" alone share 2500 hours, the rest being contributed by the "Apollo" and by six other aircraft converted to gas turbine propulsion. Against this figure America had only 15 hours' experience, with its "Turbo-Liner"; France had 25 hours, with the "Bretagne" (this with Rolls-Royce "Nene" engines); and Canada, with its "Jet Liner," 280 flying hours.

Even more significant are the orders received during the year from overseas air lines for the "Comet" and the "Viscount." These orders to date, amount to about £7½ million; Air France and an associated charter company have ordered six de Havilland "Comet" aircraft with this company's "Ghost" jet turbines, and Canadian Pacific air-lines have ordered two. Others orders are expected to materialise shortly for the longer-range Series II "Comets," which will be fitted with "Avon" jet turbines. There were foreign orders for sixteen "Viscounts," which are made by Vickers-Armstrongs, Ltd., with propeller turbines by Rolls-Royce, twelve of these being for Air France and the remainder for use by Aer Lingus.

Other export statistics show that the total value of British exports up to September, 1951, amounts to £32,857,935, of which £12½ million is contributed by complete aircraft, £6½ million by engines, £13½ million by accessories, and £329,000 by tyres. As the total export for 1950, itself a successful year, was £34½ million, the figure already attained up to September promises an even better year and brings the total exports of the aircraft industry since the war to £167 million.

Since that day in 1941 when Sir Frank Whittle's "W-IX" engine and its drawings were flown to U.S.A., there has arisen a most lucrative source of income from the manufacture under licences in that country of British gas turbines. Contracts signed this year have added another £30 million to the regular income already established from this source.

The latest contract, for a supply of Rolls-Royce "Nene" jet engines to Canada, is said to be worth 25 million dollars for the first 1000 engines alone.

Two other valuable agreements signed last year are those between the Curtiss-Wright Corporation in the U.S.A. and Armstrong-Siddeley Motors and the Bristol Aeroplane Company in Britain—both for powerful jet and turbo-prop engines which will be built for U.S. aircraft. The agreement to license the Armstrong-Siddeley "Sapphire" and other engines has been valued at 6 million dollars.

THE "VISCOUNT" — VICKERS ARMSTRONG LTD.

Other licensing agreements with Canada and the U.S.A. are held by Rolls-Royce, principally for the "Nene" and "Tay" centrifugal turbines, which are in large-scale production for American fighters.

Licences to manufacture British gas turbines now number twelve in eight different countries outside North America.

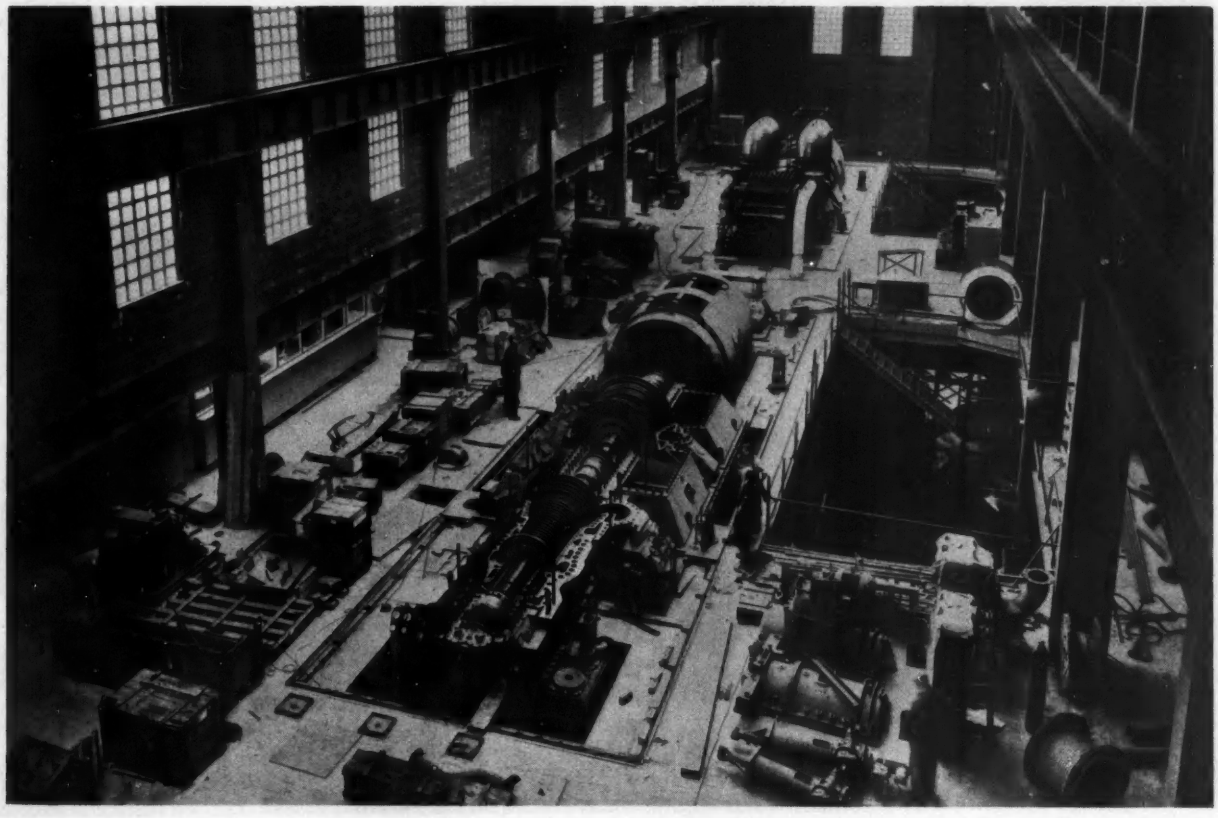
During the year the finances of one British air-line also show a most favourable and encouraging improvement. In the first half of its current financial year (April–September inclusive), British Overseas Airways Corporation made an operating profit of £974,000, which, after allowing £481,000 for interest on capital, &c., left a clear overall surplus of £133,000. It will be recalled that for the corresponding periods of last year and the year before, deficits of £2,228,000 and £4,018,000, respectively, were incurred. In making these figures known, Sir Miles Thomas, chairman of B.O.A.C., also announced that September was the best traffic month the Corporation had experienced, the revenue exceeding £3 million for the first time.

It must not be supposed that B.O.A.C.

For as far as can be revealed, the aircraft now in production are mainly designed to fulfil the requirements of high subsonic speeds with perhaps rare excursions into transonic and supersonic regions. The aircraft which will cruise at truly supersonic speeds may be quite different again from these. Neither does it appear that there has been a single solution to the many problems involved in so far as they have been resolved. The highly swept thin wing and tail configuration, characteristic of most of the latest designs in production, has been the first and most developed approach; but the delta plan form is another and radically different one, which this country, more than any, has developed. An account of the delta design, provided by the A. V. Roe Company, Ltd., was included in our description of the S.B.A.C. display. Though it is said to have posed certain control problems when built without a tail, it enjoys other quite fundamental advantages over the swept wing configuration, these becoming more distinct as the size increases. Two firms concerned with its development, and in the light of relatively recent flying experience with deltas, are convinced that the delta plan form, probably tailless, will supersede the orthodox swept wing-fuselage-tail machine.

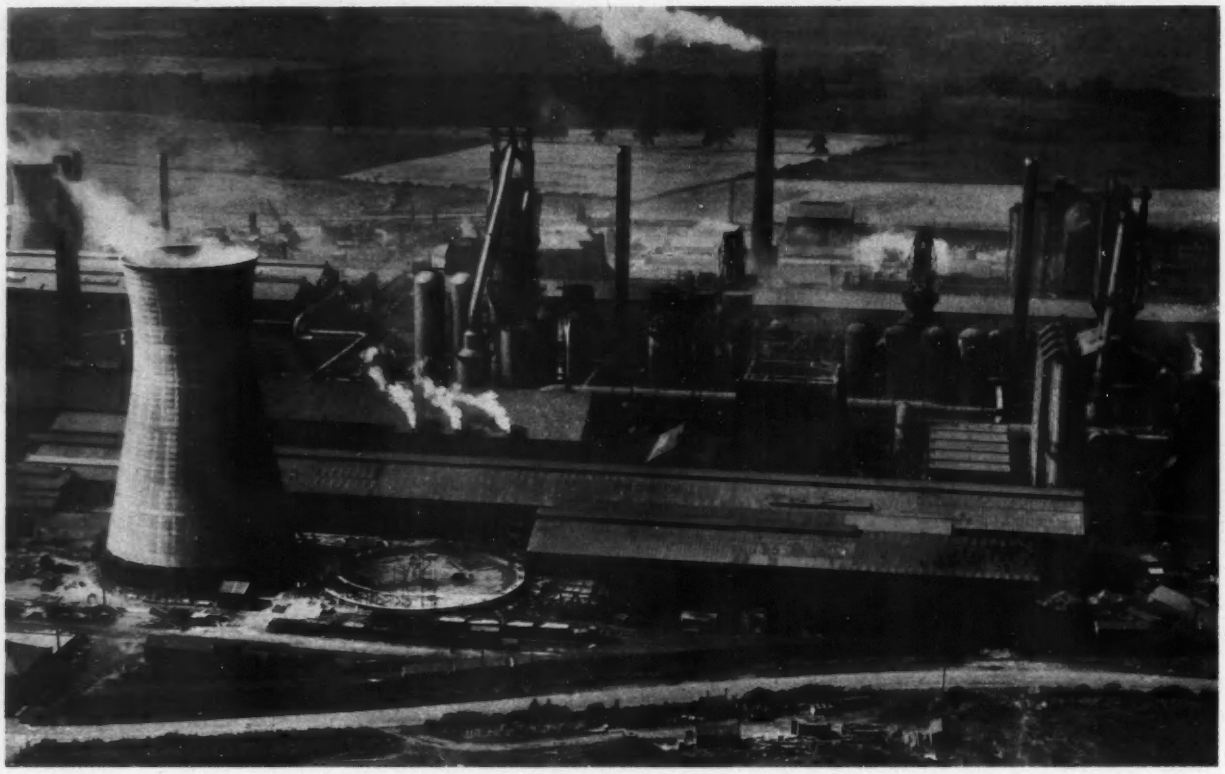
B.E.A. POWER STATIONS COMMISSIONED IN 1951

TWO 52·5MW TURBO-ALTERNATORS IN AGECROFT POWER STATION



TURBINE HOUSE, WESTWOOD POWER STATION

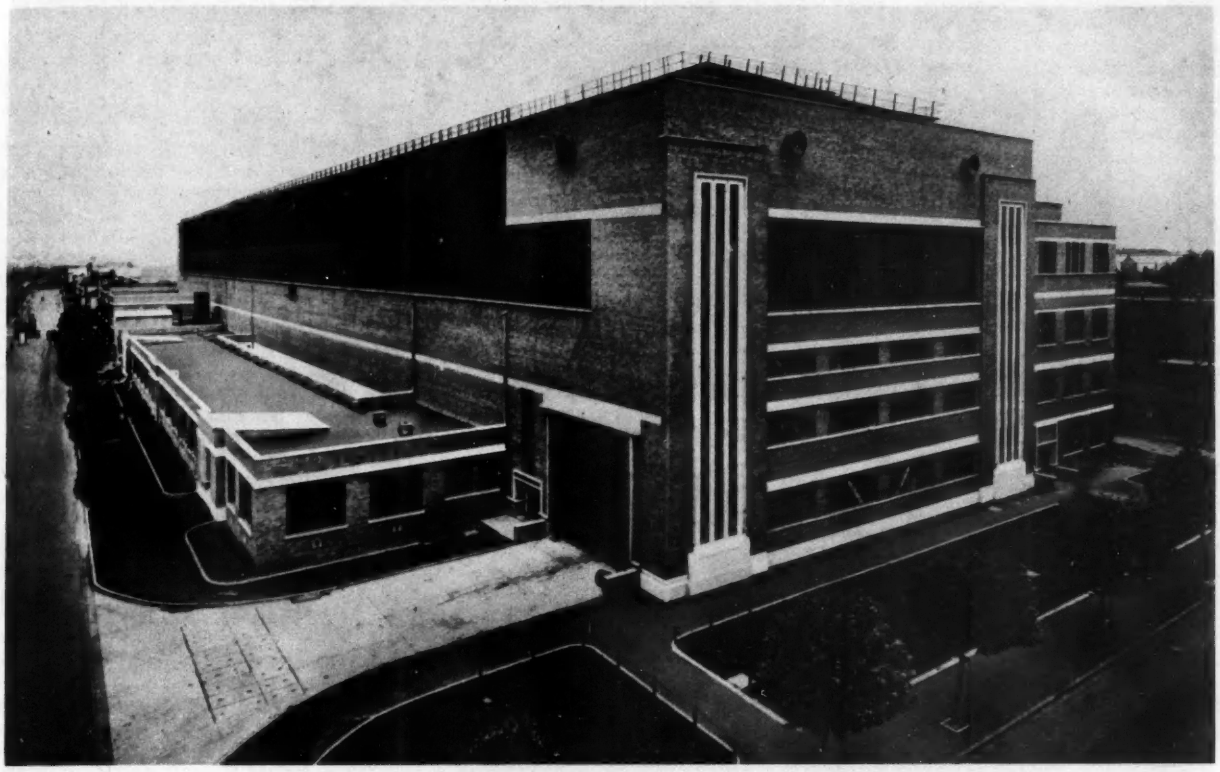
STEELWORKS OF 1951



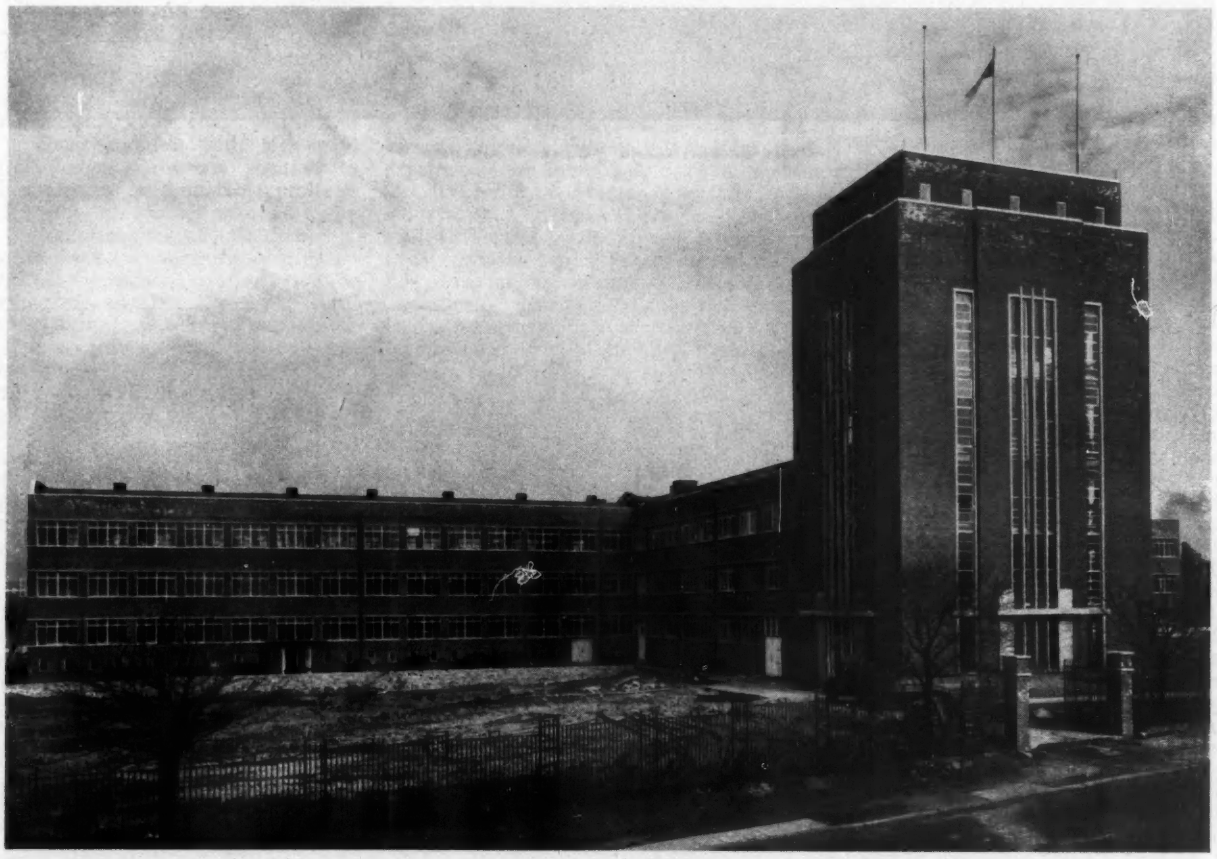
EXTENSIONS AT JOHN LYSAGHT'S SCUNTHORPE WORKS, LTD.

MARGAM WORKS—STEEL COMPANY OF WALES, LTD.

NEW WORKS OF 1951

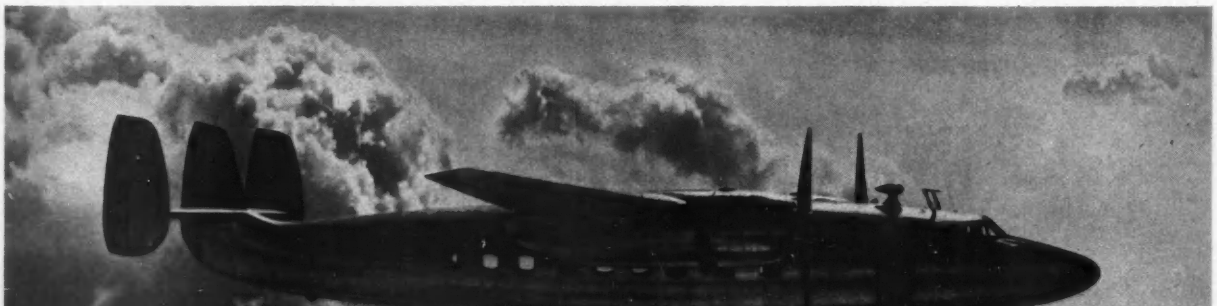


HEAVY ENGINEERING WORKS OF GENERAL ELECTRIC COMPANY



RESEARCH AND DEVELOPMENT BUILDINGS OF SIMON ENGINEERING GROUP

CIVIL AND MILITARY TRANSPORT AIRCRAFT OF 1951



THE AIRSPEED "AMBASSADOR" AIRLINER

THE DE HAVILLAND "COMET" AIRLINER

THE SAUNDERS-ROE "PRINCESS" FLYING BOAT

traffic was entirely human cargo, for during the first seven months of the year about 18,000 animals, 340,000 birds and 180,000 tropical fish were carried, and nearly all on the freighter route between Singapore and London via India, Pakistan, and the Middle East. Of the animals most were monkeys, and in a list far too long to be described were twenty storks and 200 pythons.

Some Technical Papers

Almost coinciding with the S.B.A.C. display this year was the third and probably most successful joint conference of the American Institute of Aeronautical Sciences and the Royal Aeronautical Society. It was held at Brighton from September 3rd—7th and 540 delegates attended of whom 150 were from America. There were, in all, twenty papers presented during the conference. More than half of these papers was concerned in some measure with the structural and aerodynamic problems which have been created by flight at high subsonic speeds. There were two particularly significant papers on forced boundary layer control, whilst only four other papers dealt with matters relating to propulsion.

The first session began with a paper by G. T. R. Hill, of Short Brothers and Harland, Ltd., entitled "Advances in Aircraft Structural Design." It dealt with the early history of the monoplane and the introduction of stressed skin and "sandwich" construction. The author later referred to a once prevalent fallacy in the application of the square cube law and instanced a particular authority which maintained that such would be the increase of structure weight, per cent, with size that a 5-ton aeroplane would be the heaviest to leave the ground without any useful payload. Nowadays, although that law was not disputed, many other factors—foremost amongst which was the refinement in design of non-structural parts, the extent of which in large aircraft was not previously realised—have enabled the realisation of much larger machines. The author then discussed some aero-elastic difficulties encountered with swept-back wings, and other problems manifest with high-speed structural designs. As one solution to what is stated as a formidable problem, that of landing an aircraft with a heavily swept configuration was the possibility of hinging the wing to permit variable sweep back angles in flight. This solution tended to involve an exchange of the worst aerodynamic problems for those of an engineering nature, but the author was inclined to think there was a net gain. An "aero-isoclinic" wing was also described, which had the property of maintaining its tip incidence when loaded.

A paper by N. J. Hoff, of the Polytechnic Institute of Brooklyn, on "Structural Problems of Future Aircraft," mentioned the inadequacy of thin skin constructions, suggested solutions such as integral wing skin and stiffeners, or the use of very thick skins, which may be tapered as in the supersonic Bell "XS-1" aircraft. Supersonic biplanes were next suggested, for the structural rigidity inherent in the biplane permitted a drastic reduction in wing thickness and, furthermore, part of the interference drag which had made biplanes objectionable would be absent in supersonic applications because of the concept of the "cone of silence." The paper then went on to discuss the effect of aerodynamic heating with supersonic aircraft. One conclusion of its analysis shows that the transient thermal stresses in a steel wing spar at 50,000ft at Mach No. 3·1 might exceed the yield point after two or three minutes of flight. Another paper entitled "Some Aerodynamic Advances," by A. Faye, of the National Physical Laboratory, dealt generally with recent advances made in the studies of subsonic and supersonic flow; and another paper, by A. H. Flax and H. R. Lawrence, of the Cornell Aeronautical Laboratory, dealt with methods of determining the aerodynamic characteristics of low-aspect ratio (<3) wings. An approximate method for calculating low-aspect ratio wing body interference, including the non-linear effects, was included. Swept wings was the subject of a further paper which outlined the results of tests made at the National Research Council, Canada, to determine the effect of sweep on overall stiffness and deformation. Eleven cellulose acetate models were used and the tests described were limited to semi-span wings of uniform chord, using different rib configurations and various aspect ratios, the sweep ranging from −15 deg. to +60 deg.

An account was given of the development of the Glas II 31·5 per cent thick suction aerofoil in a paper by T. S. Keeble, of the Australian Aeronautical Research Laboratories. The paper stated that the development of such an aerofoil was decided at the inaugural meeting of the British Commonwealth Advisory Aeronautical Research Council in 1946. Its profile was intended to produce a rising velocity over much of its surface. Forced boundary layer suction from slots placed towards the rear of the aerofoil was effected by suction plant placed at the wing root from where the suction air was discharged. Flight test results of the glider accommodating this wing were given and were related to the theoretical studies made. An application of the aerofoil to an all wing aircraft was examined.

In view of the work being carried out, particularly in this country, on forced boundary layer control techniques, the paper by Sir Melvill Jones and M. R. Head, of Cambridge University, was particularly significant. It was entitled "The Reduction of Drag by Distributed Suction." It related to a method of increasing the stability of the laminar boundary layer by making the aircraft surface porous and thence sucking air through it from without. Details of the experiments at Cambridge, using a model attached below the fuselage of an "Anson" aircraft, were given. The porous surface consisted of calendered nylon fabric over tightly stretched wire gauze supported on ribs. Conclusions as to the effectiveness and limitations of distributed suction were given. During the discussion on this paper Dr. Gustav Lachmann, of Handley Page, Ltd., spoke of the desirability of incorporating the suction plant within the main aircraft unit, and suggested that laminar flow would not be achieved in rain. Another important subject was treated in an excellent paper entitled "Plastics and Plastic Structures," by J. E. Gordon, head of the Plastics Structures Section at the Royal Aircraft Establishment. It describes the author's work first on the vacuum moulding, using "Durestos" felt, of several parallel test wings and, later, of a delta wing which is to be fitted to an existing airframe. This wing was now ready for loading tests. Weight for weight the mechanical properties of plastics are generally inferior to the properties of light alloys, but the paper suggests, where the torsional stiffness was not too severe, structures as light or lighter than metal ones were practicable.

A dinner was held to conclude the conference, after which Major F. B. Halford, C.B.E., president of the Royal Aeronautical Society, remarked upon the subject of security. He stated that if not watched carefully "security" could become a bogey. The faster the technical progress, the less damage leakages could do and the way to defeat the copyist was to move faster still. To move faster there must be co-operation, and if between them they could work to remove whatever barriers which now prevented their bringing out the best in one another—both forbearing merely to follow or imitate—then, as Mr. Churchill said, it would be "a successful partnership in our struggle for the way of life which is our common heritage," and the closer the two societies worked together, the more successful would be that partnership.

Civil Aviation

There were promising indications within recent months that the world's airlines will inaugurate all-the-year-round "tourist rate" services around the world. Emphasis has hitherto been placed on increasing the speed of modern airliners and the luxury of their fittings without any attempt to enlarge the scope of air travel so that its benefits may be available to a larger public.

This issue formed an important part of the agenda at the seventh International transport Association general meeting which opened on September 10th. It also considered a report by its Technical Committee dealing with the multiplicity of present-day radio aids; it was here suggested that G.C.A. should only be a primary landing aid where sighting difficulties preclude the installation of I.L.S. It maintained also that the Calvert low visibility lighting system and the U.S.-A.T.A. "Alpha" should be adopted.

It was later announced last month that British European Airways and Air France are to introduce in October of this year tourist fares 35 per cent below the standard rate on the London–Paris route. Road transport costs to and from the airport are no longer included, neither will there be free meals. Light refreshments will, however, still be available, and special food boxes will be on sale at both airports.

Similar tourist arrangements on the North Atlantic route are also being prepared.

For such traffic, special lightweight seats have been designed and built by Vickers in consultation with the British Air Lines and Air Registration Board. These seats are constructed of molybdenum steel tubing with rubber foam padding, and can be adjusted to four different reclining positions. They are designed and stressed so that they can be faced either rearwards or forwards and to stand a deceleration of 15*g*. With this tourist accommodation it is expected that sixty-eight passengers can be carried where formerly, with the more luxurious lay-out with powder rooms, &c., only forty-three were accommodated. Space saving and weight saving are critical factors in providing tourist fares. It has been shown that if an operator carries an extra 2 lb cushion on each of sixty seats in a fleet of twenty aircraft the average annual loss incurred would be about £60,000. This calculation relates to an airliner flying 2000 hours a year, but only at 200 m.p.h.; at 400 m.p.h. this figure is almost doubled.

Another issue which assumed prominence during the year relates to the strength and arrangement of aircraft seating which have, it appears, a critical bearing upon passenger survival in that minority of accidents where fire is not involved.

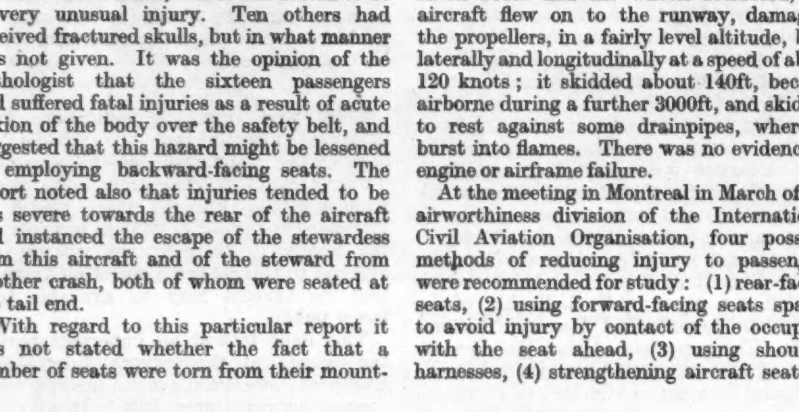
In respect of these seating problems reports of accidents to aircraft issued during the year are particularly significant. It was shown in the pathologist's report* that of the twenty-eight victims in the "Viking" air-

British Medical Journal, "Report of Post-Mortem on 'Viking' Victims." Dr. D. Teare, September 22nd, page 707.

craft which crashed and caught fire at London Airport in 1950, all received injuries from the impact causing immediate loss of consciousness or death, and were probably dead before the fire broke out or, in a few cases, within seconds afterwards. The post-mortem revealed that sixteen victims had died of injuries to the chest and upper abdomen, and of these eight had suffered a rupture of the aorta, which was stated to be a very unusual injury. Ten others had received fractured skulls, but in what manner was not given. It was the opinion of the pathologist that the sixteen passengers had suffered fatal injuries as a result of acute flexion of the body over the safety belt, and suggested that this hazard might be lessened by employing backward-facing seats. The report noted also that injuries tended to be less severe towards the rear of the aircraft and instanced the escape of the stewardess from this aircraft and of the steward from another crash, both of whom were seated at the tail end.

With regard to this particular report it was not stated whether the fact that a number of seats were torn from their mountings on impact contributed to the injuries sustained. In the case of the "Tudor" accident at Llandow in 1950 where eighty people lost their lives, displacement of the seats was much more extensive and a great number were heaped at the front of the machine. This aircraft crashed whilst landing in fine weather and in daylight, and did not catch fire. It is of interest to recount briefly the very different circumstances surrounding the accident to the "Viking" aircraft mentioned above, which attempted to over shoot after making an approach to land in 50-yard visibility. At one time over shooting was regarded as one of the most difficult operations to carry out when flying on instruments for height, speed and direction are all critical at the same time, and rapid changes of flight trim occur, corrections for which are difficult to anticipate precisely on "instruments." This aircraft left Le Bourget for Northolt when widespread fog had been forecast for that evening with a risk of visibility at Northolt of 440 yards. The visibility became, in fact, 50 yards for this period, and at London Airport 40 yards, i.e., less than the width of its runways. The pilot was informed on several occasions of this deterioration during the flight, but continued to London and attempted to land using the ground control approach radar system. The report showed that other diversionary aerodromes had visibility ranging from 1500 yards to 500 yards. After making a good instrument approach to within 400 yards of the runway and to a height of just less than 50 yards, the pilot declared his intention of overshooting. About five seconds later, with the engines developing rated boost and the wheels retracted, the aircraft flew on to the runway, damaging the propellers, in a fairly level altitude, both laterally and longitudinally at a speed of about 120 knots; it skidded about 140ft, became airborne during a further 3000ft, and skidded to rest against some drainpipes, where it burst into flames. There was no evidence of engine or airframe failure.

At the meeting in Montreal in March of the airworthiness division of the International Civil Aviation Organisation, four possible methods of reducing injury to passengers were recommended for study: (1) rear-facing seats, (2) using forward-facing seats spaced to avoid injury by contact of the occupant with the seat ahead, (3) using shoulder harnesses, (4) strengthening aircraft seats to withstand acceleration 9*g*. instead of 6*g*., as now required in the forward direction.



"MARATHON II" WITH GAS TURBINES—HANDLEY PAGE

The following month, Group Captain W. K. Stewart, medical officer at the Royal Aeronautical Establishment, Farnborough, said at a conference of the Ergonomics Research Society in Birmingham that air crash fatalities would probably be halved by the use of backward-facing aircraft passenger seats built to resist an acceleration of 25*g*. Dr. A. Buchanan Barber, chief medical officer of B.E.A., explained that to put in a seat to withstand 25*g*. involved extra weight and therefore loss of payload. B.E.A. were putting in about 40 per cent of backward-facing seats in the "Viscount" aircraft, but they would not be stressed as much as Group Captain Stewart had indicated.

At this time also it was announced that backward-facing seats will be fitted in all new Australian commercial aircraft.

Another conference was held during September at which Commonwealth and Colonial representatives met to discuss the problems peculiar to gas turbine airliners arising from their much higher speeds or the more critical operational characteristics of the gas turbine itself. The suitability and limitations of present radio aids for these aircraft was reviewed and the latest equipment was demonstrated, some of which was described in THE ENGINEER, November 30th, page 702.

It was a conclusion of the conference that it would be practicable to introduce the "Comet" airliner with existing facilities, but that realisation of its full commercial capabilities would require improvement of these facilities. Flight trials with the "Comet" had shown that jet aircraft could be fitted into existing types of traffic patterns, but that improved systems would probably be needed when jet aircraft were operated in great numbers. It was agreed that the existing network of radio sonde and radar wind stations for forecasting wind and temperature at heights up to 50,000ft must be expanded and that at certain stations the frequency of observations must be increased. The fact that jet aircraft like the "Comet" flew twice as fast as conventional piston engine aircraft emphasised the need to put into effect quickly the improvements to fixed ground communications already agreed to internationally.

The programme of trials of the "Comet" jet liner, which were reported during the year, concluded in October. The aircraft had been in the hands of B.O.A.C. and the six-month programme involved 460 hours of flying under practical air-line flying conditions. Twelve overseas tours were completed and the aircraft covered 91,000 miles, employing different long-distance cruising techniques over a wide range of geographical and climatic conditions. The programme was completed with remarkable and unexpected smoothness and with only trivial delays. On its final tour the "Comet" reached Singapore in 24 hours 35 minutes after leaving London. It was upon the knowledge gained that the broad conclusions already referred to above were based. The absence of vibration in this pure jet aircraft has been a remarkable factor in reducing air crew and passenger fatigue and accounts for the unprecedented serviceability of the radio, instruments and other accessories; moreover, the flying characteristics of the "Comet" have been pleasant and it has been found easier to handle during an instrument approach than contemporary airliners.

Similarly, the Vickers "Viscount 700" prototype returned to this country on November 30th, after completing extensive tropical and high-altitude flight trials in Africa, which entailed 105 hours' flying. The aircraft had representatives of British European Airways, the Air Registration Board and firms' technicians on board throughout the trials. This well-known prototype, which is the forerunner of the B.E.A. "Discovery" class airliner, is powered with four Rolls-Royce "Dart R. DA.3" engines, fitted with full water/methanol injection equipment.

The water/methanol injection system was completely successful during the take-offs from various high-altitude airfields. Only routine maintenance was required on both the engines and airframe, which were remarkably trouble-free during the whole tour.

First deliveries of the "Viscount" are expected in the autumn of 1952, and it is expected that it will be in operation with B.E.A. early in 1953.

In order to obtain preliminary operating experience with the "Dart" power plants, two "Dakota" aircraft fitted with these engines are now operating a freight service for B.E.A.

The future of the "Princess" flying-boat shown in Plate 8 has been much debated during the year, and a decisive Government statement has been promised as soon as possible. It will be recalled (THE ENGINEER, November 9th) that on October

30th the "Princess," mounted on her beaching chassis, was hauled on to the hangar apron in preparation for beaching and flight trials which will be undertaken this year. The main cause of the delay in flying this aircraft has been the unavoidable hold up in the delivery of her "Proteus" gas turbines.

Earlier in the year the "Brabazon" airliner obtained a limited certificate of airworthiness, and in THE ENGINEER, August 3rd issue, we described the occasion of the first non-fare-paying passenger flights. This first "Brabazon," which cost £4 million, has now logged a total of 350 flying hours.

It was expected that the Airspeed "Ambassador" (Supplement) would have been ready for service with B.E.A. this year. Further slight modifications are being made, however, before this "Elizabethan" class aircraft is available. Our illustration shows the prototype "Marathon II" transport aircraft which has "Mamba" axial flow turbines with which are incorporated reversible pitch propellers, the first "fixed" shaft turbine aircraft to be so fitted, and was first shown at Farnborough this year with these propellers.

(To be continued)

British Workshops in 1951

No. I

ALTHOUGH controls and shortages of building materials combined to curtail work on many new establishments and factory extensions for the engineering and allied industries during the past year, a fair amount of construction was completed. The fact that there still remains a heavy demand for new factory space in most parts of the country, despite the amount of building completed since the war and the release of many Government factories to private firms, is indicative of the healthy state of the order books in industry. The high level of exports has made it necessary for many firms to seek additional space and in some parts of the country the shortage of suitable sites is causing concern. As the effects of the defence programme are felt, this demand for space will doubtless continue to grow, and already there has been a substantial increase in the demand for the development certificates that must be obtained from the Board of Trade before erecting buildings of more than 5000 square feet for industrial purposes. To a certain extent the demand for space to increase production can be alleviated by the introduction of modern methods and reorganisation within works themselves, but this is a very costly business in many cases and only partially solves the problem.

Like many other old-established works in this country, those of the Power Gas Corporation, Ltd., and Ashmore, Benson, Pease and Co., at Stockton-on-Tees, have been extended from time to time to permit an increase in production and comply with the manufacturing requirements of the period. Some three years ago it was realised by the company that further extensions to the existing premises would no longer give an economic increase in production, as they would result in congestion and loss of efficiency in the manufacture of modern complicated, heavy plant. Such plant called for a completely different shop lay-out and equipment which could not be effectively merged into the works as it stood. In January, 1949, the directors of the company decided to rebuild the works progressively over a period of years and double the floor area of each of the production departments, at the same time providing facilities for still further extensions. The plan provided for the efficient manufacture of larger and heavier products in accordance with future market demands, and the provision of space for new departments likely to be required for new materials or processes which might be developed.

A site of about 100 acres was acquired about ½ mile south of the Parkfield Works of the company, and when the overall lay-out of the factory had been decided upon the detailed planning of the first stage of reconstruction was started. The first stage of the plan, which was completed in 1951, was the building of a new constructional shop of 132,000 square feet floor area, together with auxiliary services and buildings at the new "South Works."

The new shop, part of which can be seen in one of the illustrations on this page, consists of four transverse bays, each 85ft wide, 250ft long and 30ft high to the crane tracks, and two longitudinal bays, each 65ft wide, 340ft long and 50ft high to the crane tracks. In order to facilitate the transfer of heavy material and plant between the high bays and the low bays the crane tracks of the transverse bays are cantilevered out beneath these of the longitudinal bays. A services building along the side of one of the high bays contains an X-ray room, stores, substation, &c. A stockyard served by rail and road is provided at one end of the building for raw materials delivery and storage.

The shop is laid out for the manufacture of general mild steel, stainless steel and non-ferrous platework for the gas, chemical, oil and iron and steel industries, and is equipped to deal with plates up to 2in thick. At present twelve overhead cranes serve the shop, the heaviest being of 50 tons capacity. The crane tracks in the two longitudinal bays are each designed to take two 50-ton cranes which, when they are installed, will make it possible to handle any size or weight of vessel likely to be made in the foreseeable future. The lay-out is so arranged that the bulk of the processes in manufacture will be carried out in the transverse bays and one-half at the end of the longitudinal bays, whilst the main transfer, collection and distribution of material will be done in the remainder of the longitudinal bays.

A comprehensive range of equipment for the shop includes levelling rolls for plates 8ft wide by 1in thick; three sets of bending rolls for plates up to 12ft wide by 1¼in thick; plate edge planing machines, one 30ft long and the other a double-headed, 40ft machine; two guillotine shears, one for plates 12ft wide, 1in thick; a continuous welding equipment for vessels up to 160ft long; and ample X-ray facilities. Press shop equipment includes a 1150-ton flanging unit, and a 200-ton open-sided, progressive flanging press. There is also a 15ft wide by 20ft long plate heating furnace and a 25ft long bar furnace.

A new machine shop, 137ft long by 65ft wide was built for Taylor and Challen, Ltd., in Mary Ann Street, Birmingham, and opened last year. It consists of a main bay 42ft wide between stanchions with a side bay 20ft wide, the main bay being 32ft high to the trusses and the side bay 18ft high. A 25-ton overhead travelling crane which serves the main bay runs on rails 25ft above floor level and a 5-ton travelling crane in the side bay has its rails 13ft above the floor. This side bay has a flat roof and provision has been made to build floors above it in the future. One end of the main bay, with the side bay on the right-hand side can be seen in one of the photographs reproduced on p. 32.

The new building has a steel frame with brick walls and its floor of wooden blocks is laid on a concrete base. Its corrugated protected metal sheeting main roof is

CONSTRUCTIONAL SHOP OF POWER GAS CORPORATION

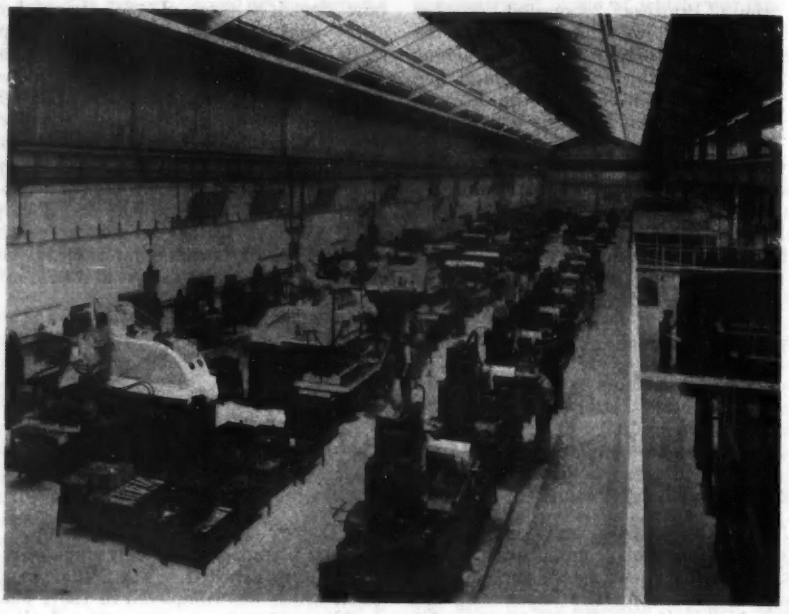
amply glazed to give good natural lighting and four 30in diameter roof ventilators are fitted. Particular attention has been paid to providing efficient artificial lighting as well as good natural lighting. In the main bay there are two rows of 400W fluorescent lamps in deep reflectors, and side lights with 750W tungsten lamps in parabolic reflectors so arranged to eliminate stroboscopic effect and give an illumination of 18 lumens per square foot at normal working level. In the side bay there are three rows of 5ft long, 80W fluorescent tubular lamps.

On the Heaton South site of the works of C. A. Parsons and Co., Ltd., of Newcastle upon Tyne, three new bays, each 60ft wide by 360ft long, have been completed. Two of these bays are 20ft to the crane rails and are duplicates of two bays constructed in 1949 and used as the coreplate and mirror shops, respectively. The bays house the turbine blade rolling and machining shops, which have been transferred from Heaton North. The new blade machining shop is shown in one of our illustrations.

The third bay for condenser building, which was completed a few weeks after the first two, is 30ft to the crane rails and the same height as new pipe shops completed last year. Steel plates and sections are delivered to this shop from the welding shops at Walkergate in correct shapes ready for welding into position. Completed condenser sections are machined, erected, tested and despatched from the new bay without entering the main Heaton Works. Now that this new shop is in operation the load on the heavy machine and erecting shops at Heaton Works is reduced and greater facilities have been made available for the manufacture of turbo-alternators. With the transfer of the original blade shops from the main works to Heaton South, two bays of the old shops used for blade work, which adjoined the transformer shop, have been demolished and in their place a new bay, specially designed for transformer production, has recently been completed. This bay, which is 80ft wide by 400ft long and 84ft high to the ridge, is served by two 100 tons capacity overhead travelling cranes. In it the largest transformers up to 275,000V or more will be constructed, and with the firm's previous transformer facilities it will give a total annual production capacity exceeding 2 million kVA.

To meet the demand for increased production and relieve congestion in existing shops, a new extension of some 45,000 square feet has been laid down by Broom and Wade, Ltd., at its High Wycombe works. Two-thirds of the extension have been completed and is now being equipped with new plant. The new extension, to be seen in a photograph we reproduce opposite, consists of three bays each of which is served by a 5 tons capacity overhead travelling crane. Ample glazing provides good natural lighting and the artificial lighting is by means of specially blended units phased to avoid stroboscopic effect.

A new briquetting plant for swarf has been installed by this firm to feed its foundry, using a system whereby cast iron swarf is collected from the machine shop in trays with perforated bottoms; after the surplus coolant has drained away, the swarf is screened before being passed on to a storage hopper. From a feed hopper the swarf passes into tubes leading down to the feed box of a press. Briquettes 3½in diameter by 1¾in thick, approximately 72 per cent density, are produced on this press at the rate of twelve a minute. The amount of swarf fed to form each briquette can be varied by means of a hand-wheel on the press. Prior to use in the cupola, the briquettes are allowed to weather for ten to fourteen days.



TURBINE BLADE SHOP AT PARSONS WORKS

Briquettes can be used as part of the metal charge up to 20 per cent and they are placed at the bottom of the charge in the skips so that they are on top when delivered to the cupola and excessive crushing is avoided. Strict laboratory control of the metal, such as is exercised in the Broom and Wade foundry, is necessary when using briquettes, as the sulphur pick-up is greater and desulphurising is carried out when the proportion of briquettes to the total charge is high, i.e., 20 per cent. During melting oxidisable constituents of the swarf, such as carbon, silicon and manganese are reduced to a greater extent than would be the case using a normal charge, and this loss must be balanced in calculating any mixtures containing swarf as a constituent.

The General Electric Company, Ltd., opened its new heavy engineering works at Witton in November, and when these new shops are in full operation the company's present output of heavy electrical generating plant will be doubled. Although this works is primarily designed for the construction and testing of large steam and water-driven alternators, it will also be used for the manufacture of heavy plant, such as rolling mill motors, winder motors, &c.

The new building, which is illustrated in Plate 7, covers an area of about 2½ acres. The main erection and test bay, which occupies the full length of the new building, is 525ft long by 100ft wide in a single span, with a height of 70ft to the eaves. Its full length is served by two 110-ton overhead travelling cranes running on rails 58ft 6in above floor level. At the incoming end of the bay are four core building pits and the erection of plant is progressively carried out along the length of the building, rotors on the left-hand side and stators on the right. When erected the machines enter a testing section at the far end of the bay, where test beds are laid out over an area of 160ft by 100ft.

Flanking the full length of the new building on the north side is a 40ft wide bay about half the length of which is used for manufacturing purposes, and the remainder for offices and stores. On the south side of the building is a single-storey office block, and an indoor substation, adjacent to the test beds in the main bay, which houses the power plant and

NEW MACHINE SHOP OF TAYLOR AND CHALLEN

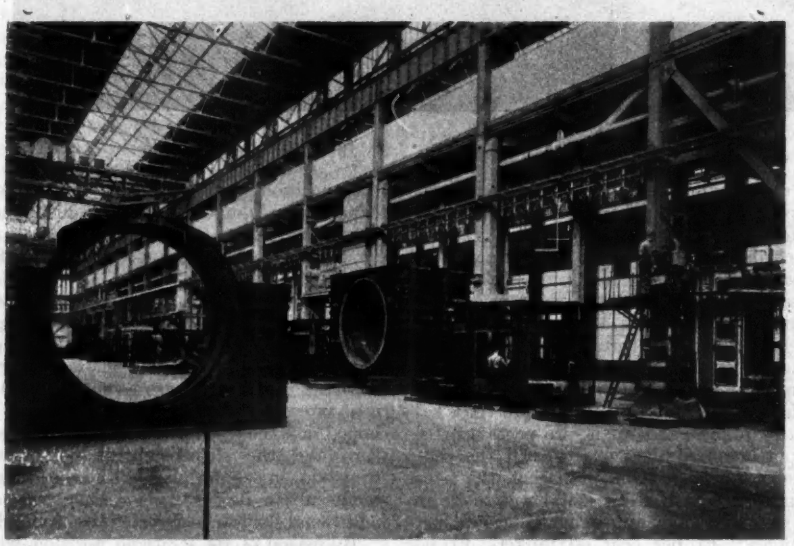
associated switchgear for test purposes and power distribution in the works. An impression of the main bay lay-out can be obtained from the illustration we reproduce on this page, and full details of the new works and its equipment were given in our issue of November 16th last.

In Coventry the Banner Lane factory of the machine tool division of Wickman, Ltd., several new departments were introduced. The extensions provided a new demonstration bay and despatch department with a loading dock, a new fettling shop and a new spraying and painting preparation department. This company also acquired existing factory space in Coventry for a new production unit for the assembly of six-spindle automatics. The company's Wimet division comprises two main factories which have been extended and reorganised to give an ultimate increase of some 80 per cent in production.

NEW SHOPS AT BROOM AND WADE WORKS

An increase of some 25 per cent in its production of woodworking machinery and machine tools has been made possible by the opening of a new factory at Gads Hill, Gillingham, Kent, by the Startrite Engineering Company, Ltd. The new works comprises a single-storey, two-bay building with a two-storey office block and a small adjoining paint shop. The workshops, which cover an area of some 3000 square feet, are served throughout their length by a 4-ton overhead crane.

One bay of the new works is equipped for the batch machining of the components for the bandsaws, saw benches, disc sanders and drilling machines manufactured by the firm. As each batch of component units is completed it is inspected and transferred to the second bay for assembly. This company also maintains a jig and tool design office for service to industry, and we are informed that this section is shortly to be transfered to new and larger premises to increase its capacity.



MAIN ERECTION BAY AT G.E.C. WITTON WORKS

RESEARCH

One of the largest private industrial research establishments in this country was opened at Cheadle Heath, Stockport, by the Simon Engineering Group in July last. The firms within this group include Simon-Carves, Ltd., Simon Handling Engineers, Ltd., Henry Simon, Ltd., and Turbine Gears, Ltd. They make a wide range of plant and the new laboratories have been designed to concentrate the work of a number of separate laboratories and research units owned by the companies in the single building illustrated in Plate 7, and described in THE ENGINEER of July 20th last.

The new research and development buildings are roughly cruciform in plan, the main arm running north to south with a cross arm projecting westward from the centre of the main arm and terminating in the six-storey tower 90ft high, which houses an experimental flour milling plant. The two lower floors of the buildings forming the main and cross arms accommodate research laboratories and administrative offices, while the third floor throughout is used for drawing-offices. On the ground floor of the west wing there is a fully equipped lecture hall capable of accommodating 200 people. The east wing of the buildings consists principally of a single-storey development building, 165ft long, 55ft 8in wide and 40ft high in the clear. This building is equipped with an overhead travelling electric crane and contains a number of pilot plants for experimental work.

The main arm and west block of the offices and laboratories are of reinforced concrete framed construction with cast-in-situ floors with frames spaced at 11ft centres. The 90ft tower is of steel-framed construction and all suspended floors are of timber spanning rolled steel joists. The development wing is of steel-framed construction with north light roof of similar design to the main building. Its floor consists of heavy precast concrete flags arranged for easy removal so that foundations for experimental apparatus can be constructed wherever required.

Another new laboratory opened in 1951 was that of the British Hydromechanics Research Association in the new town of the Harlow Development Corporation. This is a new association, controlled and financed by industry with the help of a Government grant, which has for its object advancement of the knowledge and application of fluid mechanics in the construction and utilisation of hydraulic and ancillary machinery.

The new laboratory and offices are laid down in a modified standard factory on the new industrial estate, and they have an initial floor area of 13,900 square feet with provision for future extension. The main laboratory and workshop block consists of five 72ft by 24ft bays, four of which are single-storied, and the fifth has a gallery 12ft above floor level round four walls. An adjoining two-storey office block in addition to offices provides an extra 670 square feet of laboratory floor space.

In June the Tin Research Institute of the Tin Research and Development Council opened new laboratories at Greenford, Middlesex. This Council is financed by the tin mining companies of six countries and its researches are directed into the development and promotion of uses of tin and its alloys. The new three-storey research building has its ground floor divided into three main bays. The central bay contains the general metallurgical laboratory and the adjacent bays an electro-chemical laboratory and plating workshop, and a number of smaller laboratories. On the first floor of the building are the photographic department, main hall and library, whilst the third floor is divided up to provide additional analytical and corrosion research laboratories. As a result of its researches the Institute has, amongst other work, made notable contributions to electro-chemistry, particularly in connection with the electro-deposition of tin alloys. With the enlarged premises and equipment now at its disposal it has been possible to embark on an extended field of research into tin and its uses.

(To be continued)

SWEDISH SHIPPING.—It is reported that Sweden's shipping tonnage in liner traffic has increased to 935,000 from 587,000 in 1937. The ocean traffic tonnage has risen to 692,000 from 366,000 and that in European traffic to 111,000 from 52,000. North Sea tonnage, on the other hand, has decreased by 1000 to 84,000, while Baltic tonnage has increased by a similar figure to 21,000. Tanker tonnage has increased to 367,000 from 136,000, reflecting expanded demands for oil.

Shipbuilding and Marine Engineering in 1951

No. I

WITH full order books and ships waiting to be laid down, the economic position of British shipbuilding presented, at the end of the year, an encouraging picture for the future and ensured, altogether apart from the contracts placed for naval vessels, full conditions of employment, for some time to come, for those engaged in the industry.

In contrast with the satisfactory shipbuilding situation, the ship-repairing industry suffered from a shortage of work, and there was some unemployment. This state of affairs was the consequence of a number of causes, including the completion of the huge liner conversion programme on which a large labour force had been engaged, since the war, in refitting the ships for their normal peacetime duties after release from war service. Other factors were the completion of a large backlog of ship surveys which were postponed due to war conditions and the existing high freight rates, coupled with a heavy demand for tonnage, which influenced owners to retain ships in service for a longer period between surveys. Included in the rearmament programme are the repair of naval vessels of the Reserve Fleet and the conversion of others for new duties and the placing of contracts for this work helped to alleviate conditions obtaining in the industry.

The 1951 order book was a record one for British shipbuilding, and included about 700 ships, either under construction or with material ordered, plus nearly 300 more for which plans have yet to be approved. These contracts represented approximately a total of 6,500,000 gross tons, with a value approaching £600,000,000, calculated on prices at current levels, and of this huge total approximately one-third represents the value of ships building for foreign owners. The volume of orders placed means that the shipyards had enough ships being built, and to lay down, to keep the berths occupied until 1956, without booking any more contracts, at the present annual rate of production, which amounts to 1,300,000 tons and is largely controlled by the availability of supplies of material, particularly steel. A bigger allocation of steel to the industry would result in a proportionate reduction in the time to build the ships on the order book.

The world political scene and the war in Korea had a marked effect on the placing of tonnage. Pressure of events and other factors continued to cause freight rates to rise and the demand for cargo space to increase, so that the prospect of greater earnings influenced owners to place orders before delivery dates became too remote. During the year about 4,000,000 gross tons of ships were ordered, a figure which represents a substantial increase over that of 1950 and approaches ten times the tonnage placed in 1949 when unemployment in the industry was a distinct possibility.

Lloyd's Register Shipbuilding Returns showed an increase in the tonnage commenced in each quarter : oil tankers represented 55 per cent of the ships building, while, of the tonnage preparing, about 68 per cent was for this class of ship, so that the proportion of oil tanker tonnage under construction would increase. The returns, which included the figures for Germany and Japan, but not those for China, Poland and Russia, indicated that the work in hand in British shipyards was about 42 per cent of all ships being built throughout the world.

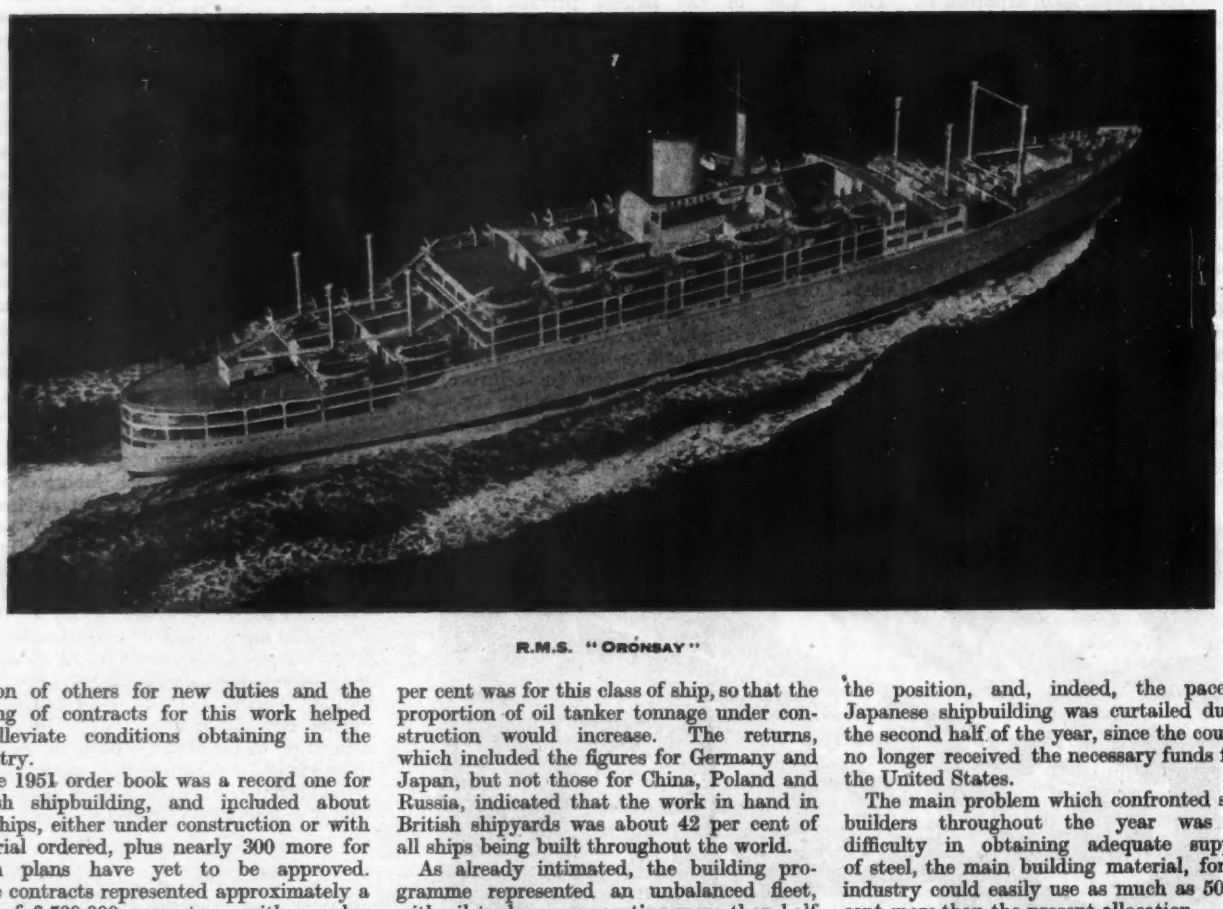
As already intimated, the building programme represented an unbalanced fleet, with oil tankers representing more than half of the orders and with prospects of this proportion becoming greater. Of the ships under construction and preparing, the latest returns showed that the total was made up of the following approximate group percentages :—61 per cent oil tankers, 21 per cent cargo ships, 7 per cent passenger and passenger cargo liners, 6 per cent cargo tramps, and the remainder coasters and special service vessels. From the foregoing it can be seen that the industry owed its prosperous state mainly to the orders placed by the oil companies, such as the British Tanker Company, Ltd., and the Anglo-Saxon Petroleum Company, Ltd. The comparative shortage of orders for passenger liners tended to reduce the work for the finishing trades, and more orders were placed by tramp owners. Although the overall position indicated a full order book, the disproportionate amount of tonnage ordered for the various classes of ships meant that some yards were not so well placed as others, and that there was the prospect of an early delivery for vessels of an intermediate class.

The labour force employed remained steady, at a figure considerably in excess of the total engaged in 1939, although there was an increased number engaged on new work which was offset by a corresponding drop in those employed in ship repairing. Wages increased during the year, but it was considered that boom conditions and the state of trade would enable the shipping industry to absorb the higher building costs.

Both Germany and Japan each had under construction more than 400,000 gross tons, a volume which put them among the leading shipbuilding nations. However, with the present rate of world shipbuilding the competition of these countries did not affect the position, and, indeed, the pace of Japanese shipbuilding was curtailed during the second half of the year, since the country no longer received the necessary funds from the United States.

The main problem which confronted shipbuilders throughout the year was the difficulty in obtaining adequate supplies of steel, the main building material, for the industry could easily use as much as 50 per cent more than the present allocation. It is hoped that the restrictions on capital expenditure and the suspension of non-essential projects, in conformity with the requirements of the defence programme, will cause additional steel to be diverted to shipbuilding.

By reason of its strategic position within the rearmament plan, the industry should



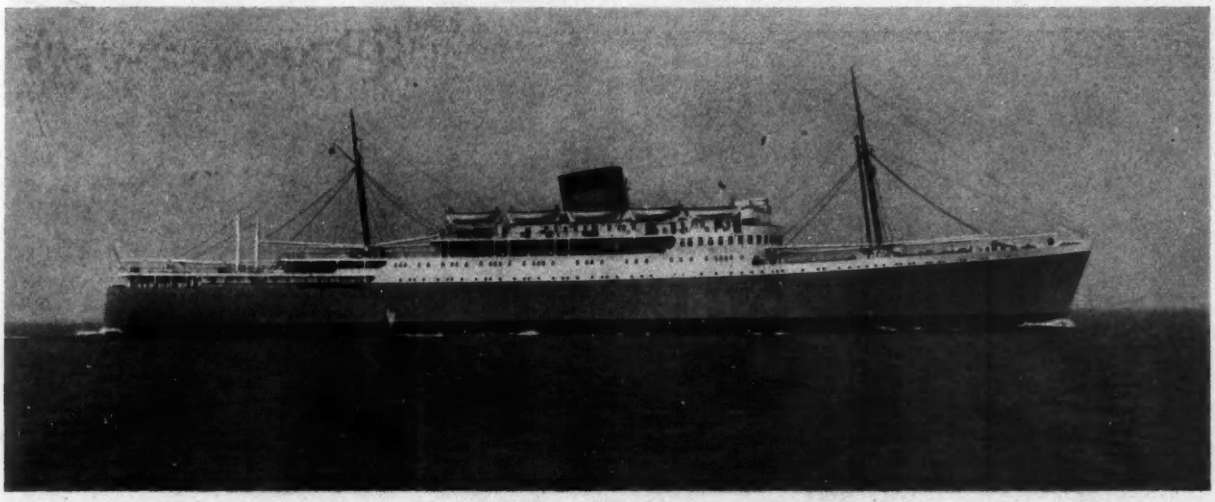
R.M.S. "ORONSAY"

be allocated a considerable share of any steel received from America. Viewed as an economic proposition the steel supply position has a considerable effect on the level of costs because a larger allocation of steel would directly influence ship delivery dates so that vessels would be in service much earlier than anticipated, thus helping to reduce costs, whereas the longer the ship is kept in the stocks the more powerful is the reverse effect. Should the flow of steel to the shipyards not be increased, then, to ease the situation, it may be necessary to save steel by making a closer study of the size of ship required for a particular trade and to give greater consideration to the economic speed. Apart from the influence of steel supplies on the delivery date, shipbuilders throughout the year endeavoured to reduce building time by continued efforts to improve efficiency by introducing modern equipment for prefabrication, building new cranes having heavier lifts, and improving the lay-out of the yards so that the flow of material to the berths was expedited.

During the year shipowners, at launches and other functions, stressed the high prices of ships, the effect of taxation, depreciation allowances, balancing charges and the turn round in port. The old order of fixed price with the profit determined by the skill of the shipbuilder showed no sign of returning to replace the conditions of fixed profit and an unknown final price. With regard to taxation, shipowners pointed out that the continuance of the present basis of assessment for taxation, which included that part of the profits to be set aside for tonnage replacement, would have the effect of gradually reducing the size of the merchant fleet. It was necessary for owners to make additional provision out of earnings to bridge the gap between the depreciation allowance and the actual cost of new ships, for if the depreciation charged against profits was based on the original cost, no shipping company could survive when it is remembered that prices are approximately three times the pre-war level. Another disturbing factor in this question of replacement was the increasing age of the merchant fleet, about 30 per cent of which was twenty-five years old and over, whereas most countries had fleets with a smaller percentage of old tonnage and the shipowners were treated more generously in the matter of replacements. The contribution of the country's shipping services to the balance of trade amounted to about £150,000,000 in 1951, so that the need to keep the fleet up to strength with a steady flow of replacements was clearly apparent. The views of the General Council of British Shipping on taxation was sent in the form of a memorandum to the Royal Commission on Taxation of Profits and Income.

The factors affecting the economics of shipping were discussed, particularly the waste of carrying capacity due to bulk buying and the slow turn round in port. It was stressed that the ship and port formed an economic unit. Ships had improved in efficiency and had higher speed, but these advantages were more than offset by the increasing time spent in port, where as much as three-fifths of the expenses were incurred. The solution of the problem, apart from labour questions, was a matter of the technical equipment and organisation of the ports, and the formation of the International Cargo Handling Co-ordination Committee last October holds out hope that many of the technical problems will be solved.

Another matter of some concern was the decline of coastal shipping, due in part to the increased proportion of tonnage owned by nationalised undertakings and to rates discrepancies.



S.S. "RHODESIA CASTLE"

British Shipbuilding Research

The year 1951 has been one of intense activity in the field of research, and, indeed, the total volume of the investigations and experimental work continued to increase. This expansion indicated that the British Shipbuilding Research Association, under its technical director, Dr. Livingston Smith, and the Research Council, has yet to attain its optimum with regard to the scope and range of the widely varied problems coming within its directive. Of particular note was the volume of work carried out on board ship and this continually expanded during the year, so that such investigations have begun to assume their proper proportion in relation to the other activities of the Association.

By the size of the programme of work put in hand, last year and in previous years, by the British Shipbuilding Research Association and other bodies, it is evident that British shipbuilding is more research minded than ever before. This condition, which made this nation supreme in the art of shipbuilding, and which is essential if Britain is to remain in the lead and so, by its shipbuilding activities and shipping services, continue to contribute largely to the balance of payments. The work of the Association was surveyed by Sir Maurice Denny in a paper given in 1950, and some indication of the extent of merchant ship research in this country was given by Dr. Livingston Smith in his paper "The Organisation of Merchant Shipbuilding Research in Great Britain," which he read before the Society of Naval Architects and Marine Engineers at the summer meeting held in September last year in Washington, U.S.A.

The paper described how scientific research, designed to increase the knowledge of naval architecture and marine engineering, is organised in Great Britain. The first part of the paper dealt with the general organisation of industrial research and also the manner in which the Government expressed its interest through the medium of the Department of Scientific and Industrial Research. Shipbuilding research was described and the links with associated bodies mentioned. Charts indicated the relationship between the various associations, while others gave the detail organisation of the Admiralty, Department of Scientific and Industrial Research, and the committee arrangements of the British Shipbuilding Research Association. The discussion, which ensued, revealed an intense international interest in research as organised in this country and indicated the intention to set up similar bodies in other countries.

The initial trials of the "Lucy Ashton" took place in 1950 and an account appeared in our issue of August 25th of that year. Since then the trials have been completed and the corresponding work in the tank on a scale model proceeded steadily throughout the year and now has reached a very advanced stage. An analysis of the full-scale results were completed and given by Sir Maurice Denny in his paper, "B.S.R.A. Resistance Experiments on the 'Lucy Ashton,' Part 1: Full-Scale Measurements," an abstract of which was published in THE ENGINEER on July 6th. The paper described the tests, the instrumentation for the trials, hull surface roughness measurement and included a discussion of the results together with naked hull resistance curves. After reading the paper Sir Maurice gave some figures related to the increase in resistance due to fouling.

As an indication of the activities of the Association it can be stated that during 1951 about thirty-two reports were issued to members six of which were issued for publication in the technical press.

The machine, which is intended for full-scale structural component tests, was finally

assembled at Glengarnock during the year. The two machines are owned by the B.S.R.A. and the programme of work to be carried out is the concern of the Ships' Structures Committee of the Association, while the operation of the machines is under the supervision of Lloyd's Register. This co-operation ensures that the results achieved receive practical expression through modifications of the Society's rules.

A full programme of work concerning the determination of loads, stresses and deflections in ships' structures was put in hand during the year in conjunction with Lloyd's and the Imperial College, London. The two main investigations were to find the effect of varying the distribution of structural material by bending a series of parallel thin flanged box girders, and to carry out pure bending tests on a transversely stiffened hull box girder, measuring 6ft by 4ft, in order to obtain a detailed stress distribution over the cross section before finding the effect, on this stress distribution, of adding deckhouses of various widths. To enable the work to be put in hand the experimental facilities of the College were augmented.

Within the industry intense interest was maintained in ship and model correlation, such interest having been stimulated by the considerable amount of work on laminar and turbulent flow which has received much attention during the post-war years. The Association, in collaboration with the ship division of the N.P.L., actively pursued the study of ship and model correlation during the year, and the staff attended a number of loaded ship trials, to measure full-scale performance, while the N.P.L. provided the corresponding model data. By this means essential information was added to the fund of data, which is being built up and which is necessary if the better prediction of ship performance from model tests is to be achieved.

Regarding propelling machinery problems, work proceeded during the year on the two single-cylinder, opposed piston experimental engines of 5in bore by 15in stroke, under construction at Vickers-Armstrongs and Co., Ltd., at Barrow, and which are intended for use in the study of the scavenge process in the two-cycle marine diesel. The preparation of a programme of tests with the experimental engines formed part of the year's work. At the same time, in association with Vickers-Armstrong and Co., Ltd., experimental work was carried out regarding the best method of obtaining spring cards. A series of light spring card tests were carried out on various engines as opportunity presented, and the information gained is being analysed.

In the past year the B.S.R.A., in collaboration with the British Ceramics Research Association, experimented in an effort to bring about an improvement in refractory and brick bolt materials so that they can withstand better the comparatively high temperatures in high-pressure boilers and also have better insulation qualities and so help to reduce heat losses. A number of ships were surveyed and representatives of both associations examined boiler brickwork and obtained details of service performances. Samples of brickwork from boilers in several ships were sent to the laboratories for examination.

The study of the corrosion problems concerning boiler tubes was continued at the Chemical Research Laboratory, Teddington, as were the investigations into the means of improving the corrosion-resistant properties of mild steel tubes. Another item was a survey of the existing data, linked with some experimental investigations, on the maximum bearing pressures and rubbing velocities permissible with mild steel crankshafts and with various kinds of bearing surfaces. These investigations covered problems concerning the top end bearing and main guides of diesel and steam engines and the work proceeded in conjunction with the Mechanical Engineering Research Organisation at West Kilbride.

Ventilation problems were studied during the year and the fundamental data, which was collected by a member of the staff who made two round voyages to Australia, was subjected to a detailed analysis. A preliminary study was carried out on the distribution of loads along nuts and on the fatigue of bolts and studs, and a large-scale investigation was undertaken, as a joint research project, by the Association and the Naval Construction Research Establishment of the Admiralty at Rosyth. The aim of the work, which is proceeding, is to provide design information and the experiments involve the testing of typical engine bolts of 3in and 1in diameter to determine the strength of the bolts when subjected to sinusoidal loading superimposed on a constant prestress.

The Association was engaged during the year on a comprehensive series of investigations of vibration, which were designed to cover both the theoretical and the practical approach to the subject. The vibration problems were investigated from the point of view of both the naval architect and the marine engineer, and a number of tests were made on board several ships. This experimental work and other investigations were used to check the theoretical work aimed to improve the methods of calculating ship vibration frequencies and, in some cases, it was necessary to use the Lloyd's Register vibration exciter in order to generate the various modes of vibration. An important part of the vibration tests entailed an investigation of the strength and stiffness of engine seatings and had particular reference to misalignment and crankshaft failures. The results of much of the work was presented in two papers given before the North-East Coast Institution of Engineers and Shipbuilders.

Further research was instigated into the sources of noise in engine-rooms and the methods of insulating cabins from structure-borne noise. With regard to the performance of the ship at sea and on measured mile trials, the Association recommended a standard code of trial procedure, which is now widely adopted. As previously stated, members of the staff attended many load trials and an essential part of the work was to devise and test improved methods of recording torque and thrust, and a paper read before the Institute of Marine Engineers gave a review of the results. The analysis of trial results is largely undertaken by the Association's staff and the data accumulated during the year was circulated to assist shipbuilders in the correlation of ship and model.

(To be continued)

T.S.S. "OCEAN MONARCH"

Industrial and Labour Notes

The Coal Situation

In the last week of the year, ended December 29th, the saleable output of coal from the deep mines amounted to 2,274,800 tons, and from opencast workings 74,000 tons, giving a total for the week of 2,348,800 tons. In the comparable week of 1950 output amounted to 2,581,200 tons. This week the Ministry of Fuel and Power has stated that coal production in the fifty-two weeks of last year, ended December 29th, totalled 222,117,500 tons, which was nearly 6,000,000 tons more than in 1950. The number of wage earners on colliery books on December 15th was 697,200, of whom 286,300 were face workers. At the end of 1950 the number on colliery books was 688,000, of whom 284,700 were working at the face. Distributed stocks of coal on December 15th amounted to 16,927,000 tons.

Last week-end the National Coal Board announced increases in the price of coal, which became effective on December 31st. It was explained that the recent agreement with the National Union of Mineworkers for increased wages and holiday pay would add 3s. 4d. a ton to the cost of coal production, and that the Board had to meet also heavy increases in the cost of timber and other materials needed for maintaining and increasing the output of the mines. The extra amount involved in that connection is put at 1s. 10d. a ton, in addition to the 3s. 4d. required to meet the cost of the wage agreement. The National Coal Board has therefore raised the pithead price of all coals despatched from the collieries or loaded into ships for inland destinations by an average of 5s. a ton. For all inland coal, apart from house coal, the Board has taken this opportunity to introduce another instalment of its rational price structure, whereby pithead prices are to be fixed according to the quality of the coal, as determined by scientific analysis and commercial knowledge. Within the average increase of 5s. a ton the prices of individual industrial and carbonisation coals are therefore being varied by differing amounts according to quality.

The Census of Production

The Board of Trade has stated that the Census of Production in respect of 1952—which is to be taken next year—is to be simplified. The forms will contain fewer questions than in any previous census and "sampling" will be introduced for the first time. The census will cover all producing industries as hitherto, and returns will be required from all firms over a certain size in each trade. But a "sample" will be taken of smaller firms, which means that the majority of them will not be required to make a return.

The statutory return form will include questions on working proprietors, average employment during the year, wages and salaries, plant, machinery and vehicles, new building work, total materials and fuel purchased, work given out, stocks at the beginning and end of the year, total output, and transport payments. The principal simplifications, compared with previous censuses, are in respect of output, materials purchased, employment, and wages and salaries. Under those headings totals only will be required and not detailed analyses as formerly. It is believed that the changes, which have been made after consultation with the Census of Production Advisory Committee, will reduce the burden upon industry and will result in economies in the census of production office at the Board of Trade.

Changes in Wage Rates

The latest statistics on changes in wage rates, issued by the Ministry of Labour, show that during November last about 3,096,000 workpeople received increases aggregating £1,419,000 a week. The principal increases affected workers employed in the engineering and allied industries, shipbuilding and ship-repairing, the railway service, the iron and steel industry, the motor vehicle retail and repair trade, and the gas industry.

In the engineering and allied industries and in shipbuilding and ship-repairing there was an increase of 11s. a week for adult male time-workers and payment-by-result workers, and for workpeople employed by British Railways there was an increase of 8 per cent on existing rates of pay. The increases payable in the iron and steel industry were made under the sliding scale arrangements based on the index of retail prices. In the motor vehicle retail and repair trade, skilled and semi-skilled adult male workers received an increase on the minimum rates of 3d. an hour and other adult male workers received 2½d. In the gas industry the increases were of 3d. an hour in the standard rates for maintenance craftsmen and of 2d. an hour or 1s. 4d. a shift, for other adult workers. The changes coming into operation in November had the effect of raising the index of rates of wages (June, 1947=100) to 125 for all workers. At the end of October, the index stood at 122, and at the end of December, 1950, it was 114.

The Ministry of Labour has stated that, in the first eleven months of last year, the changes in wage rates involved an aggregate weekly increase of £5,940,400 in the wages of 11,943,500 workpeople. In the corresponding months of 1950 there was an aggregate increase of £1,797,500 in the weekly full-time wages of 6,752,000 workpeople.

Trade Disputes

Stoppages of work during November last through industrial disputes in the United Kingdom resulted in a loss of 91,000 working days by 35,900 workpeople. During that month, there were 137 stoppages reported, twenty of which were in progress before the beginning of November. There were fewer stoppages of work in November than in October, when 113,000 working days were lost by 30,000 people concerned in 212 stoppages through disputes. The majority of the November stoppages were in the coal mining industry, where 25,000 working days were lost by 13,000 miners. In the first eleven months of last year there were 1633 stoppages of work through disputes, reported to the Ministry of Labour. In them 369,600 workpeople were involved directly and indirectly, with the result that 1,650,000 working days were lost. In the corresponding period of 1950 there was a loss of 1,361,000 working days by 294,800 workpeople concerned in 1266 stoppages.

Scrap Prices

The Minister of Supply has made an Order, entitled the Iron and Steel Scrap (No. 5) Order, 1951, by which the controlled maximum prices of delivered iron and steel scrap have been increased as from December 31st. The increases vary, according to district and specification, from 1s. 8d. to 3s. 6d. a ton. It is stated by the Ministry that these increases reflect the rise in railway freight charges which took effect on December 31st.

Another Order made by the Minister of Supply is the Aluminium Scrap Prices (No. 2) Order, 1951, which authorises, from January 1st, price increases for aluminium scrap. The Order establishes a maximum price of £148 a ton for new pure aluminium foil scrap suitable for use in the manufacture of aluminium flake powder and aluminium paste. The maximum prices formerly prescribed for other kinds of aluminium scrap and aluminium alloy scrap have been increased by amounts varying from £10 to £17 a ton. They take account of the increase from £124 to £148 per long ton in the price of virgin aluminium, which dates from January 1st.

Copper and Zinc Allocations

Allocations of copper and zinc for the first quarter of this year have recently been announced by the copper, zinc and lead committee of the International Materials Conference. The countries represented on the committee are the United Kingdom, the U.S.A., Australia, Belgium, Canada, Chile, France, the Federal Republic of Germany, Italy, Mexico, Norway and Peru. All of them have accepted the allocations. In the case of the United Kingdom the quarter's allocations are 100,000 metric tons of copper and 64,000 metric tons of zinc.

The committee states that only primary copper and zinc have been allocated, and there has been no allocation scheme for semi-fabricated products. Exports of semi-fabricated products, however, are to be maintained at a level commensurate with the exporting country's allocations of metal. The demands for defence and essential civilian needs increased during the fourth quarter of 1951, and in view of that the committee has decided, temporarily, to make no provision for strategic stockpiling. But that decision, it is stated, has been taken without prejudice to the principle of making such provision in future allocations. The allocations for each participating country represent the amount of metal which may be processed or consumed by the country concerned, either from domestic production or imports, but they do not specify from which sources a country's metal shall be obtained. Each country is, therefore, free within its allocation to purchase from any source or sell to any destination, but it is suggested that, as far as possible, the normal patterns of trade should be followed. In accepting the distribution plans, participating countries assume the responsibility for seeing that their allocations are not exceeded.

The Canadian Association of British Manufacturers

A report on the first six months' work of the Canadian Association of British Manufacturers and Agencies was given recently by the president, Mr. Lewis Forbes, at a general meeting of the Association in Toronto. He said that in the short period of its existence the Association had already proved to be of effective assistance in many aspects of the development of United Kingdom-Canadian trade.

Mr. Forbes stated that the matters already dealt with by the Association included general "market possibility" reports, requests for assistance in ascertaining methods of distribution, the setting-up and incorporation of British subsidiary companies, introductions to Canadian consumers, information of a financial and commercial nature, and guidance on customs procedure. It was clear, he added, that more and more firms were turning to the Canadian market, despite the fact that many of them could keep their works fully supplied with profitable orders from sterling markets. Mr. Forbes urged that visits of Canadian buyers and industrialists to Britain were much to be desired. They would thus acquire, he said, a first-hand knowledge of conditions in Britain.

Work Stoppages in the U.S.A.

Information about stoppages of work through industrial disputes in the U.S.A. during 1950 was recently published by the United States Department of Labor. It disclosed that the number of disputes which occurred in 1950 was higher than in any of the preceding three years. Since 1946, when 4985 strikes were reported, the numbers had been substantially lower, with very little variation in each of the post-war years. But in 1950 the total number of stoppages—including those in progress when the year opened—was 4963, an increase of more than one-third on the number reported in 1949. It is estimated that, in 1950, there were 2,410,000 workers involved in these stoppages and that there was an aggregate loss of 38,800,000 working days. More than half the disputes leading to stoppages of work arose from wage claims and related matters, including pension and social insurance plans.

Notes and Memoranda

Rail and Road

GILLINGHAM BUS ACCIDENT INQUIRY.—Under the provisions of Section 23 of the Road Traffic Act, 1930, the Minister of Transport has appointed Sir Robert H. Tolerton, C.B., C.B.E., to hold an inquiry into the cause of an accident involving a double-decked omnibus which occurred in Dock Road, Gillingham, Kent, on December 4th last. The date and place of the inquiry will be announced later. Before his retirement in 1948, Sir Robert Tolerton was an under secretary in the Ministry of Transport.

THE BRITISH MOTOR INDUSTRY'S EXPORTS.—The Society of Motor Manufacturers and Traders has stated that several motor-car export records were achieved in the month of November. The largest shipments of cars ever made in one month, namely, 37,837, were sent overseas in November, a total 5530 more than in the previous month. In value, these consignments reached a record of £13,128,131 during the month. Commercial vehicle exports in November also set a new record in number and value, the 14,298 units exported being worth £7,425,980. Agricultural tractor exports in November also exceeded the October total by 444 and numbered 11,263 units with a total value of £4,165,714. In the same month the value of parts and accessories of motor vehicles and tractors exported reached £7,989,662. During November, Australia constituted the largest export market for cars, commercial vehicles and agricultural tractors, the figures amounting to 15,466 cars, valued at £3,916,366; 4903 commercial vehicles, valued at £2,183,353, and 2399 agricultural tractors, valued at £801,860.

Air and Water

RADIO TELEPHONES IN TANKERS.—The oil tanker fleet of the Esso Petroleum Company, Ltd., is to be fitted with very high frequency radio telephones, to enable the ships to keep in contact with the company's radio-transmitting station at the Fawley refinery, Southampton.

THE LATE MR. F. W. DUGDALE.—We have learned with regret of the death of Mr. Francis William Dugdale, which occurred at his home in Sunderland on December 27th. Mr. Dugdale, who was fifty-nine, was managing director of S. P. Austin and Son, Ltd., the Wear Shipbuilding and ship-repairing firm.

S.B.A.C. FLYING DISPLAY AND EXHIBITION, 1952.—The Society of British Aircraft Constructors announces that the 1952 Flying Display and Exhibition will be held in the first week of September. It will be open to guests invited by the Society on September 3rd, 4th and 5th, and will be opened to the public on the following two days, Saturday and Sunday, September 6th and 7th. There will be the usual preview for technicians and the Press on Tuesday, September 2nd.

CARGO HANDLING.—The Executive Committee of the International Cargo Handling Co-ordination Association approved a draft Constitution at a meeting held in Paris in November and another meeting of the committee will be held in Antwerp this month. An international meeting will be held in Rotterdam in April, at which a number of papers relevant to cargo handling will be presented and visits to the ports of Rotterdam and Amsterdam are being arranged for the delegates.

THE LATE SIR ARTHUR BAXTER.—It is with regret that we record the death of Sir Arthur J. Baxter, K.B.E., D.S.C., R.D., R.N.R., at the age of sixty-one years, at his home at Petersham. Sir Arthur, who was a former commodore of the Orient Line, first went to sea in 1904 and joined the Orient Line in 1913, gaining his first command, the "Orsova," in 1933. In the first world war Sir Arthur was in command of a destroyer and sank a German submarine; in the second world war he was engaged in trooping voyages before he joined the Royal Navy with the rank of Acting Commodore and appointed Commodore of Convoys. For a year Sir Arthur was A.D.C. to the King and was made a K.B.E. in 1944. On being demobilised he was promoted to Commodore and placed on the retired list and then he returned to the Orient Line, of which he was appointed the first commodore in 1948, finally retiring in 1949.

OCEAN TRANSPORTATION.—A special report of the Economic Co-operation Administration on current developments in Ocean transportation, illustrates developments by means of graphs and diagrams. The rapid increase in the demands on world shipping following the invasion of Korea is shown and also their intensification due to the renewed export of coal from the United States, caused by the lag in European coal output. Dislocations in the tramp shipping market are shown in the curve of rising freight rates and the effect of the world's increased demand for oil and the Iranian crisis is reflected by a hump in the tanker rate index. To meet the steeply rising tramp freight rates, ships were commissioned from the reserve fleet and the resultant downward trend of the rate curve is shown on a graph. Other diagrams in the report refer to the coal exports at Hampton Roads and figures are given which show that United States ships carried more than 50 per cent of the tonnage of both outgoing and incoming cargoes.

Miscellanea

LONDON'S TELEPHONE SERVICE.—The General Post Office has stated that during the month of November last, the average number of telephone calls made in London each week was 32,539,000. In the preceding month the weekly average number was 32,389,000.

OVERSEAS ECONOMIC SURVEYS.—Surveys of economic and commercial conditions in Venezuela and Canada have now been published by H.M. Stationery Office, price 7s. and 6s. 6d. respectively. They are the latest volumes in the series of overseas economic surveys issued by the Commercial Relations and Exports Department of the Board of Trade.

CITY AND GUILDS FELLOWSHIP.—The Council of the City and Guilds of London Institute has conferred the Fellowship of the Institute upon Mr. Atholl Blair, C.B.E., M.I.Mech.E., engine works manager and a director of Harland and Wolff, Ltd., Belfast, and Mr. Harry Shoosmith, M.I.C.E., M.I.Mech.E., Wh.Sch., chairman of Plenty and Son, Ltd., Newbury, Berks.

INSTITUTION OF SANITARY ENGINEERS.—The president for 1952 of the Institution of Sanitary Engineers, Mr. S. Brassey-Edwards, B.Eng., M.I.C.E., M.Cons.E., F.R.San.I., will be inducted at a meeting to be held on Thursday next, January 10th, at 6 p.m. at Caxton Hall, Westminster, S.W.1. Following his induction, Mr. Brassey-Edwards will deliver his presidential address.

AGRICULTURAL CONFERENCE.—The annual conference of agricultural members of the Royal Institution of Chartered Surveyors will take place at the Institution on Tuesday, January 29, 1952. During the morning session, starting at 11 a.m., an address will be given by Mr. B. S. Furneaux, on "Soil Surveys in Relation to Farm Valuations," followed by a discussion. At the afternoon session a panel of members will answer questions on points arising in agricultural practice.

RECONSTRUCTION OF AVONMOUTH OIL INSTALLATION.—The storage tankage and loading facilities of the Regent Oil Company's Avonmouth installation, which was destroyed by fire last September, are being replanned and rebuilt. The new lay-out provides for each storage tank being contained in its own fire bund and for the maximum protection of pipe lines. The tanks not affected by the fire have been brought into operation again by means of special arrangements of the pump-houses and loading bridge.

ANGLO-SWEDISH TRADE NEGOTIATIONS.—The Board of Trade says that trade negotiations which have been proceeding for several weeks in London between delegations representing the United Kingdom and Sweden have now been successfully concluded. The negotiations covered deliveries of iron ore and other important commodities to the United Kingdom for the whole of 1952, and of coal, coke and steel and other essential materials to Sweden in the same period. Provision has also been made for the export trade of the two countries in 1952 in addition to that in essential materials, although both delegations recognised that it might be necessary to have further discussion in the early spring about such export trade in the second half of this year.

FUEL ECONOMY IN THE MALTING INDUSTRY.—The fuel efficiency bulletin No. 52, which has just been issued by the Ministry of Fuel and Power, is entitled *Power and Fuel in the Malting Industry*. Under three main headings it is designed to cover the principle fuel and power requirements and processes of the majority of maltings in this country. The bulletin deals first with the movement of grain and malt and the economies of handling systems. Under the main heading of air conditioning for germination various sources of heat wastage are listed and means of reducing such losses described. Kilning, which is considered the most important aspect of the malting process where fuel can be saved, is dealt with in some detail, and a number of suggestions are made towards this end. The bulletin is obtainable from His Majesty's Stationery Office at 1s. 3d.

THE LATE MR. R. C. WADE.—We regret to record the death, on December 20th last, of Mr. Robert Capel Wade, of British Insulated Callender's Construction Company, Ltd. Mr. Wade, who was forty-six, was the company's engineer in charge of the contract for the installation of the overhead equipment on the Manchester–Sheffield railway electrification scheme. He was educated at Rossall School and Birmingham University, and, subsequently, joined the former B.I. Cables Company in July, 1928, as an engineer in the contract Department. Between 1928 and 1937, Mr. Wade had a very varied experience on cable and overhead line contracts and, from 1937 to 1939, was assistant engineer in Warsaw for the electrification of the Polish State Railways. On his return from Poland, Mr. Wade worked as an assistant on the Liverpool Street–Shenfield electrification contract, and during the war took charge of his company's airfield contracts. As soon as the Manchester–Sheffield electrification was recommenced after the war, Mr. Wade was appointed resident engineer in charge.

Personal and Business

THE SECRETARIAT OF THE INTERNATIONAL CARGO HANDLING CO-ORDINATION ASSOCIATION has moved to 39, Wilton Road, London, S.W.1.

MRS. DORCAS E. CROFT has succeeded her late husband, Mr. Stanley Croft, as chairman and managing director of Stancroft, Ltd., Birmingham.

MESSRS. LIVESEY AND HENDERSON state that their address has been changed to National House, 12–18, Moorgate, London, E.C.2 (telephone, Monarch 2173; telegrams, "Livesey, London").

MR. S. S. JEWSBURY, M.I.H.V.E., who has retired from the board of G. N. Haden and Sons, Ltd., has joined the consulting firm of R. W. Gregory and Partners, Pilgrim House, Newcastle upon Tyne, 1.

THE CHESHIRE ENGINEERING COMPANY, Ltd., Alliance House, Caxton Street, London, S.W.1, has been appointed sole distributor for Europe and the Commonwealth of the "Pengo" earth boring auger.

WELLWORTHY PISTON RINGS, Ltd., Lymington, Hants, announces that Mr. F. Blackith, technical manager; Mr. C. A. Clarke, engineer, and Mr. B. W. Angel, works manager, have been appointed directors.

THE MINISTER OF TRANSPORT has appointed Mr. W. P. James to be licensing authority for the West Midland Traffic Area in succession to Mr. R. Stuart Pilcher, C.B.E., who retires under the age limit on January 29th.

MR. C. W. MARSHALL, B.Sc. (Eng.), M.I.E.E., deputy chief engineer (research) of the British Electricity Authority, has been appointed controller of the S.W. Scotland Generation Division in succession to the late Mr. E. J. Edgar.

CANADIAN PACIFIC STEAMSHIPS, Ltd., announces that Captain R. N. Stuart, V.C., D.S.O., who has served thirty-eight years with the company, retired on January 1st and that he has been succeeded, as general manager of the company in the United Kingdom, by Captain E. A. Shergold.

KEITH BLACKMAN, Ltd., Mill Mead Road, Tottenham, N.17, states that Mr. D. S. Woodley, A.M.I.Mech.E., chief engineer and deputy chairman, has been appointed joint managing director with Mr. Montague Burningham. Mr. S. E. Nelson has been appointed to succeed Mr. Woodley as chief engineer of the company.

ELLIOTT BROTHERS (LONDON), Ltd., Century Works, Lewisham, S.E.13, and James Gordon and Co., Ltd., Dalston Gardens, Stanmore, Middlesex, announce that they have developed the Elliott-Hagan control system for steam plants. Inquiries concerning the system will receive attention from either of the two companies.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., states that Mr. H. F. Farmer has relinquished his position as superintendent of the control gear factory at Rugby to join the works manager's department, Rugby, for special duties. Mr. P. J. Dawton, assistant superintendent, has succeeded Mr. Farmer as superintendent of the control gear factory.

EFFINGHAM STEEL WORKS, Ltd., Sheffield, announces the retirement of Mr. Herbert T. Bradbury, on December 31st, from the position of managing director. Mr. Bradbury, who joined the firm fifty-five years ago, will continue to serve as chairman. Mr. B. H. Barber and Mr. P. Wilson Marsh have been appointed joint managing directors.

British Patent Specifications

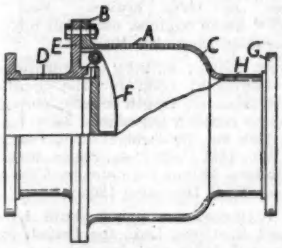
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

VALVES

662,653. February 8, 1949.—Fabricated Valves, Joseph Leslie Inshaw, The Mill, Easterhouse, near Glasgow.

This invention relates to improvements in the construction of fabricated valves, more especially non-return valves. In the drawing, *A* is the intermediate valve section formed with a flange *B*, which is reduced to a smaller diameter at *C*. The



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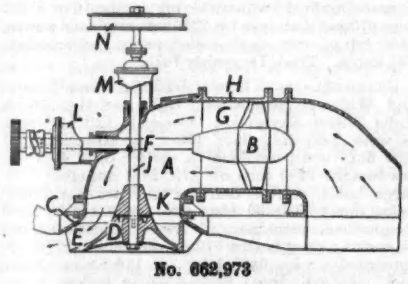
end section *D* has a flange *E* bolted to the flange *B*. A flap valve *F* is pivoted as shown to the end section *D* and co-operative with a seat fixed to the end of that section. The opposite end section *G* is expanded in diameter and welded to the reduced portion *C* of the intermediate section *A*. The construction described and illustrated is claimed to obviate the use of castings, and to provide a strong construction of valve body.—*December* 12, 1951.

MARINE ENGINEERING

662,973. April 8, 1949.—Hydraulic Propulsion and Manœuvring Apparatus, The Gill Propeller Company, Ltd., 17, Victoria Street, London, S.W.1. (*Inventor: James Herbert Wainwright Gill.*)

The object of the invention is to provide a compact hydraulic propulsion and manœuvring apparatus for hydraulic jet propulsion units for manœuvring vessels having one or more main propulsion elements. From the drawing it will be seen that the apparatus comprises a small radius right-angle bend *A*, the upper end lying in a substantially vertical plane and connected to the outlet of a horizontal axial flow pump *B*. The lower end lies in a horizontal plane and is connected to a short flared discharge passage *C* opening through the skin of the hull of a vessel. This passage contains a rotatable deflector nozzle member *D* which projects



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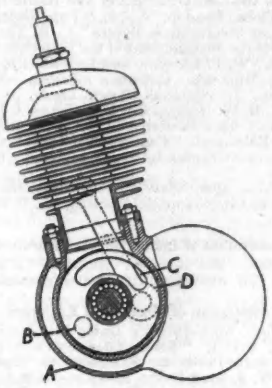
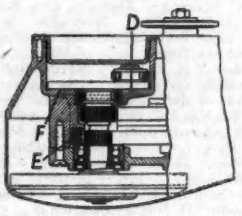
beyond the end of the passage and contains one or more nozzle passages *E* arranged to deflect the water delivered through the bend and discharge it in the form of one or more jets, each having a substantial horizontal component and a small downward vertical component. The two axes of the bend *A* are somewhat offset laterally to allow the two spindles to pass each other in the bend. The impeller's spindle *F* is supported on its discharge side in a bearing carried by a spider *G* formed integral with or mounted within the tubular casing *H*. The deflector nozzle spindle *J* is supported in a bearing carried by a spider *K* from the wall of the outlet end of the bend of the discharge passage. The hub of the impeller *B* is directly connected to one end of the driving spindle *F* which passes through a gland in the wall of the bend and has its outer end supported in an external bearing *L* carried by the outer wall of the bend. The outer end of the spindle beyond the bearing is connected to a motor through a dog clutch. The spindle *J* on which the deflector nozzle member is mounted passes through a gland in the wall of the bend and an external bearing *M*, beyond which it is coupled to control mechanism, such as a wheel *N* or tiller, by which it can be rotated.—*December* 12, 1951.

INTERNAL COMBUSTION ENGINES

662,921. November 19, 1949.—Admission Gear for Two-Stroke Internal Combustion Engine, Frank Christopher Potts, 12, Church Street, Liverpool. (*Communicated by Victoriawerke A.G., a German company, of 53, Ludwig Feuerbachstrasse, Nuernberg, Germany.*)

Referring to the drawing, in the casing *A* of the engine is the gas intake opening *B*. The crank cheek comprises a concentrically extending slot *C*





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which uncovers the fuel air mixture intake opening. As illustrated, the crank cheek is mounted on a crankshaft which is mounted in a member *D*, secured to the casing by means of a roller bearing having rollers free to slide in an axial direction on an outer ring. At the other end the crankshaft is mounted in another ball bearing, whose outer ring is acted upon by a number of springs *E* distributed round its circumference. Thus the crank cheek is forced on to the wall *F* in which the fuel air mixture intake opening *B* is provided so that a reliable packing is ensured.—*December* 12, 1951.

MISCELLANEOUS

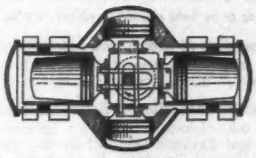
663,018. November 17, 1949.—Chimneys or Funnels for Land Vehicles or Marine Craft, Société des Forges et Chantiers de la Mediterranee, of 25, Boulevard Malesherbes, Paris, France; and Jacques Valensi, of 391, bis Rue Paradis, Marseille, France.

This invention relates to chimneys or funnels, in particular for land vehicles and marine craft, and it consists of an improvement or modification of the invention described in Specification 639,875. The illustration in this specification shows the top of the funnel fairing, which is completely closed and is flat and horizontal. The smoke flue communicates with the exterior through a pair of outlet channels which are disposed laterally in the upper portion of the funnel or chimney, and are symmetrical in relation to the centre plane. The channels are of square section, and in marine work are directed backwards towards the stern of the ship. With this construction it has been found that a satisfactory guiding effect is obtained for the smoke jet, however high the rate of discharge from the flue outlets, and with a wide range of angles of incidence.—*December* 12, 1951.

AIR ENGINES

663,092. September 10, 1948.—Reciprocating Hot Gas Engines and Refrigerating Engines Operating on the Reversed Hot Gas Engine Principle, N. V. Philips' Gloeilampenfabrieken, of Emmasingel 29, Eindhoven, Holland.

According to the drawing, a closed cycle reciprocating hot gas engine comprises four cylinders, arranged on two centre lines enclosing an angle of 90 deg. and grouped about the main shaft of the engine. The pistons are rigidly coupled to one another and their movements are determined by a body which is rotatable about an eccentric on the main shaft of the engine. The body has a cross-section which is square in a plane normal to the main shaft of the engine, a piston surface, and is separated from the surface, co-operating with a needle bearing so that only rolling friction can occur between the two surfaces. Each cycle of the engine is performed partly in one cylinder and partly in another cylinder arranged on a different centre line. The cylinders situated on the same centre line com-



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prise cold spaces or hot spaces, the heat exchangers and regenerator surrounding either of the two cylinders in which the cycle is performed. The term "hot gas reciprocating engine" is understood in this case to include a refrigerator operating on the reversed hot gas engine principle. The engine has, it is claimed, the advantage that it may be constructed in a very compact manner, since transmission members, such as piston-rods, crossheads, cranks, &c., are dispensed with.—*December* 19, 1951.

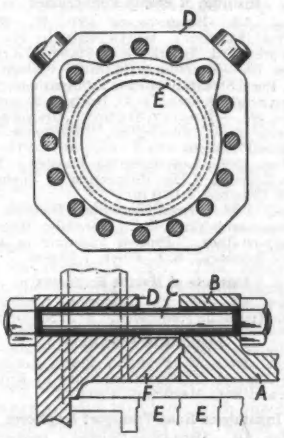
PUMPS

662,729. December 16, 1948.—Centrifugal Pumps, International Combustion, Ltd., 19, Woburn Place, London, W.C.1. (*Inventors: Walter Fred Harlow and Frank Gregory Goodwin.*)

The invention relates to centrifugal pumps of the type comprising an impeller having a disc with a boss, main impeller blades being mounted on one side of the disc and auxiliary blades of larger diameter than the main blades mounted on the other side of the disc. Its object is to overcome a drawback from which such pumps normally suffer, namely, serious cracking difficulties which often result in fractures. A drawing of the pump accompanies the specification. The boss is formed of a soft grade of iron, whilst the remainder of the impeller is formed of iron of a harder grade. The soft iron boss is separated from the other part of the impeller by a screwed tubular metal shell.—*December* 12, 1951.

663,293. April 1, 1949.—Multi-Stage Centrifugal Pumps, The Harland Engineering Company, Ltd., Alloa, Scotland. (*Inventor: Harold Henry Anderson.*)

This invention relates to multi-stage centrifugal pumps and concerns a modification or development of the invention described and claimed in the parent Specification No. 606,947. Referring to the drawings, it will be seen that the pump comprises a barrel *A* having a flange *B* to which is detachably secured by means of relatively long bolts *C* an end cover *D* with inlet and discharge branches. Housed



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within the barrel are chambers or stages *E*. A distance piece *F* integral with the end cover *D* is located in the joint between the end cover and the barrel *A*. The distance piece *F* is in the form of an annulus having two radially extending lugs, each of which serves to locate a relatively short bolt securing the barrel at points where there are gaps in the ring of bolts adjacent to the inlet and discharge branches incorporated in the end cover. The provision of the distance piece ensures that the main joint between the barrel and end cover are some distance from the inlet and outlet branches, a critical point for the temperature fluctuation.—*December* 19, 1951.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Bronze and Brass Founders

Wed., Jan. 9th.—Clarendon Restaurant, Hammersmith, "The Ingot," W. G. Mochrie; luncheon 12.45 p.m.

British Institution of Radio Engineers

Wed., Jan. 9th.—LONDON SECTION: School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, "Crystal Triodes," E. G. James and G. M. Wells, 6.30 p.m.——N.E. SECTION: Neville Hall, Westgate Road, Newcastle upon Tyne, "Test Gear Design," A. W. Wray, 6 p.m.

Cleveland Institution of Engineers

Mon., Jan. 7th.—Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Recent Developments in American Rolling Mills," R. Stewartson, 6.30 p.m.

Electric Railway Society

Sat., Jan. 5th.—Fred Tallant Hall, Drummond Street, London, N.W.1, "A Pictorial Survey of Electric Railways in Holland and Belgium," G. W. Morant, 3 p.m.

Illuminating Engineering Society

To-day, Jan. 4th.—BATH AND BRISTOL CENTRE: S.W. Electricity Board, Old Bridge, Bath, "Neon Lighting," C. Higgins, 7 p.m.——BIRMINGHAM CENTRE: Imperial Hotel, Temple Street, Birmingham, "Modern Transport Lighting," W. E. J. Drake, 6 p.m.——HUDDERSFIELD GROUP: Electricity Showroom, Market Street, Huddersfield, "The Use and Misuse of Fluorescent Lighting," T. C. Holdsworth, 7.15 p.m.

Tues., Jan. 8th.—Royal Society of Arts, John Adam Street, London, W.C.2, "Lenses for Lighthouses," W. M. Hampton, 6 p.m.——LIVERPOOL CENTRE: Merseyside and N. Wales Electricity Board's Service Centre, Whitechapel, Liverpool, "Brightness Engineering," W. Robinson, 6 p.m.

Wed., Jan. 9th.—EDINBURGH CENTRE: Lighting and Cleansing Department, 357, High Street, Edinburgh, "Measurement of Light in the Eighteenth Century," H. Buckley, 7 p.m.——NEWCASTLE CENTRE: Newe Theatre, Pilgrim Street, Newcastle upon Tyne, "Development of the Tungsten Lamp," by B. P. Dudding, 6.15 p.m.

Incorporated Plant Engineers

Tues., Jan. 8th.—E. LANCS BRANCH: Engineers' Club, Albert Square, Manchester, "Secondary Air and its Application," H. Hetherington, 7.15 p.m.——EDINBURGH BRANCH: 25, Charlotte Square, Edinburgh, "Organisation of Scientific Research in Great Britain," H. Buckley, 7 p.m.

Wed., Jan. 9th.—E. MIDLANDS BRANCH: Welbeck Hotel, Nottingham, "Building a Passenger Liner," J. Melville, 7 p.m.

Thurs., Jan. 10th.—KENT BRANCH: Queen's Head Hotel, Maidstone, "Automatic Combustion Control as Applicable to Industrial Type Boilers," Mr. Clifton, 7 p.m.——NEWCASTLE UPON TYNE BRANCH: Roadway House, Oxford Street, Newcastle upon Tyne, "Fuel Injection Equipment," W. H. Simpson, 7.30 p.m.

Institute of British Foundrymen

Sat., Jan. 5th.—BIRMINGHAM AND W. MIDLANDS STUDENTS' SECTION: Works visit to Round Oak Steel Works, Ltd., Brierley Hill, Staffs, 10 a.m.

Mon., Jan. 7th.—SHEFFIELD BRANCH: College of Technology, Pond Street, Sheffield, 1, "Synthetic Resins as Foundry Sand Binders," P. G. Pentz, 7.30 p.m.

Tues., Jan. 8th.—BURNLEY SECTION: Grammar School, Blackburn Road, Accrington, "Phosphor Bronze," E. Jackson, 7.30 p.m.

Thurs., Jan. 10th.—LINCOLNSHIRE BRANCH: Technical College, Lincoln, "The Production of Turbine Castings," N. Charlton, 7.15 p.m.

Fri., Jan. 11th.—MIDDLESBROUGH BRANCH: Head Wrightson and Co., Ltd., Teesdale Iron Works, Thornaby-on-Tees, "Process Planning in the Steel Foundry Industry," S. L. Finch, 7.30 p.m.

Institute of Marine Engineers

Tues., Jan. 8th.—85, The Minories, London, E.C.3, "Diesel-Hydraulic Propulsion," F. J. Mayor, 5.30 p.m.

Institute of Petroleum

Wed., Jan. 9th.—26, Portland Place, London, W.1, "Some Aspects of Field Operations in Kuwait," E. Boaden and E. C. Masterson, 5.30 p.m.

Institute of Road Transport Engineers

To-day, Jan. 4th.—MIDLANDS CENTRE: Imperial Hotel, Temple Street, Birmingham, "Modern Transport Lighting," W. E. J. Drake, 6 p.m.

Tues., Jan. 8th.—WESTERN GROUP: Visit to the Works of Bristol Tramways and Carriage Co., 2.15 p.m.; Grand Hotel, Bristol, "The Servicing of Brakes," J. W. Kinchin, 7.30 p.m.——EASTERN GROUP: Royal George Hotel, Colchester Road, Ipswich, "The Development of the High-Speed Diesel Engine," S. Johnson, 7 p.m.

Wed., Jan. 9th.—E. MIDLANDS CENTRE: Mechanics Institute, Nottingham, "The Use of Aluminium for Road Vehicle Body Construction," R. Esmonde, 7.30 p.m.

Institution of Chemical Engineers

Tues., Jan. 8th.—Geological Society, Burlington House, Piccadilly, London, W.1, "The Design and Performance of Cyclone Separators," C. J. Stairmand, 5.30 p.m.

Institution of Civil Engineers

Tues., Jan. 8th.—Great George Street, Westminster, London, S.W.1, "The Organisation of Airport Construction," Patrick Hogan, 5.30 p.m.

Thurs., Jan. 10th.—MIDLANDS ASSOCIATION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Sewage Purification," David M. Watson, 6 p.m.——N.W. ASSOCIATION: Engineers' Club, Albert Square, Manchester, "Tunnelling Plant and Equipment," G. C. Archer, 6.30 p.m.

Institution of Electrical Engineers

Mon., Jan. 7th.—S. MIDLANDS CENTRE: James Watt Memorial Institute, Great Charles Street, Birmingham, "The Protection of Electrical Power Stations: A Critical Review of Present-Day Practice and Recent Progress," H. Leyburn and C. H. W. Lackey, 6 p.m.

Tues., Jan. 8th.—MEASUREMENTS AND RADIO SECTIONS: Savoy Place, London, W.C.2, "Two Electronic Resistence or Conductance Meters," L. B. Turner; "A Bridge for the Measurement of the Dielectric Constants of Gases," W. F. Lovering and L. Wiltshire, 5.30 p.m.——N. MIDLAND CENTRE: British Electricity Authority, 1, Whitehall Road, Leeds, 1, "Crystal Diodes," R. W. Douglas and E. J. James, 6.30 p.m.

Wed., Jan. 9th.—SCOTTISH CENTRE: Heriot-Watt College, Edinburgh, "Transient Theory of Synchronous Generators Connected to Power Systems," B. Adkins, 7 p.m.

Thurs., Jan. 10th.—Savoy Place, London, W.C.2, "Electricity in Newspaper Printing," A. T. Robertson, 5.30 p.m.

Institution of Industrial Administration

To-day, Jan. 4th.—LONDON CENTRE: Management House, Hill Street, W.1, annual general meeting 7 p.m.

Institution of Mechanical Engineers

To-day, Jan. 4th.—Storey's Gate, St James's Park, London, S.W.1, "Some Considerations on Bogie Design, with Particular Reference to Electric Railways," W. S. Graff-Baker, 5.30 p.m.——N.E. BRANCH, GRADUATES' SECTION: Northern Gas Board Showrooms, Grainger Street, Newcastle upon Tyne, "Modern Large Turbo-Alternator Construction and Erection," W. G. Bryce.

Mon., Jan. 7th.—N.E. BRANCH: Neville Hall, Westgate Road, Newcastle upon Tyne, "The Measurement and Interpretation of Machinery Noise, with Special Reference to Oil Engines," C. H. Bradbury, 6 p.m.

Tues., Jan. 8th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, London, S.W.1, "Stability of Single-Track Vehicles," R. A. Wilson-Jones, 5.30 p.m.——S. WALES BRANCH: S. Wales Institute of Engineers, Park Place, Cardiff, annual meeting, "Some Fuel and Power Projects," H. Roxbee Cox, 6 p.m.

Wed., Jan. 9th.—SOUTHERN BRANCH: British Electricity Authority's Rooms, High Street, Portsmouth, Chairman's Address, R. D. Pegge, 7 p.m.

Thurs., Jan. 10th.—SCOTTISH BRANCH: Royal Technical College, Glasgow, "Steel Castings and the Engineer," J. F. B. Jackson, 7.30 p.m.——YORKSHIRE BRANCH: Hotel Metropole, King Street, Leeds, Annual General Meeting, 6 p.m.; annual dinner, 7 p.m.

Fri., Jan. 11th.—SCOTTISH BRANCH: North British Station Hotel, Glasgow, "Steel Castings and the Engineer," J. F. B. Jackson, 6.30 p.m.

Institution of Production Engineers

Mon., Jan. 7th.—HALIFAX SENIOR AND GRADUATE SECTION: George Hotel, Huddersfield, "Steam Turbine Manufacture," A. C. Annis, 7.15 p.m.

Tues., Jan. 8th.—BIRMINGHAM SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Vitreous Enamelling," S. Hallsworth, 7 p.m.——DUNDEE SECTION: Mathers Hotel, Whitehall Crescent, Dundee, "Production Engineering in Textiles," G. A. D. Coghlan, 7.45 p.m

Wed. Jan. 9th.—LIVERPOOL SECTION: Radiant House, Bold Street, Liverpool, "Magnetic Separation," 7.15 p.m.——PRESTON SECTION: The Bull and Royal, Church Street, Preston, "The Manufacture of Steels," C. C. Hodgson, 7.15 p.m.

Thurs., Jan. 10th.—BIRMINGHAM SECTION: Imperial Hotel, Birmingham, "Industrial Management and the Accountant," A. B. Waring, 6.30 p.m.——LONDON SECTION: Royal Empire Society, Northumberland Avenue, W.C.2, "Building a Locomotive," G. Rigby, 7 p.m.——LUTON GRADUATE SECTION: Court House, St. Albans, "Industrial Building," G. A. J. Storey, 7.30 p.m.——ROCHESTER AND DISTRICT SECTION: Sun Hotel, Chatham, "Induction Hardening," R. H. Barfield, 7.30 p.m.——SOUTHERN SECTION: Polygon Hotel, Southampton, "Electronics as an Aid to Productivity," J. L. Gray, 7 p.m.

Institution of Structural Engineers

Wed., Jan. 9th.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Reconstruction of Houdon-on-Tyne Gas Works," W. R. Garrett, 6.30 p.m.

Junior Institution of Engineers

To-day, Jan. 4th.—39, Victoria Street, London, S.W.1, film evening, "Rocket Flight," introduced by S. G. Clark, 6.30 p.m.

Mon., Jan. 7th.—N.W. SECTION: Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester, Chairman's address, A. Eaton, 7.30 p.m.

Fri., Jan. 11th.—39, Victoria Street, London, S.W.1, "Aircraft Hydraulics," E. H. Bowers, 6.30 p.m.

Liverpool Engineering Society

Mon., Jan 7th.—Royal Institution, Colquitt Street, Liverpool, "Modern Developments in Electric Welding," H. G. Taylor, 6.30 p.m.

Liverpool Metallurgical Society

Fri. Jan. 11th.—Electricity Service Centre, Whitechapel, Liverpool, "The Use of Radioactive Tracers in Metallurgical Research," H. M. Finniston, 7 p.m.

Manchester Association of Engineers

Fri., Jan. 11th.—Engineers' Club, Albert Square, Manchester, "Modern Engineering Aspects of Water Supply," R. W. Clarke, 6.45 p.m.

Newcomen Society

Wed., Jan. 9th.—Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1, "Early Refining of Pig Iron in England," H. R. Schubert, 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Fri., Jan. 11th.—Mining Institute, Newcastle upon Tyne, "Fuelling at Sea," I. McD. Black, 6.15 p.m.

Launches and Trial Trips

EGREMONT, passenger ferry; built by Philip and Son, Ltd., for the Ferries Committee of Wallasey Corporation; length between perpendiculars 145ft, breadth moulded 34ft, depth moulded 12ft 3in; 1750 passengers on normal ferry service and 700 passengers on river cruises; two Crossley "H.R.L.8" diesel engines, each 640 b.h.p. at 370 r.p.m. Launch, December 10th.

CROYDON, collier; built by the Burntisland Shipbuilding Company, Ltd., for the South-Eastern Gas Board, London; length between perpendiculars 265ft 10in, breadth moulded 39ft 6in, depth moulded 18ft 6in, deadweight 2875 tons, draught loaded 17ft 1½in; British Polar diesel engine, eight cylinders, 340mm diameter by 570mm stroke, 1150 b.h.p. Trial, December 12th.

LORD WARDEN, car ferry; built by William Denny and Brothers, Ltd., for British Railways; length overall 361ft 6in, breadth at main deck 59ft, breadth at water line 51ft, depth to main deck 17ft 9in, draught loaded 12ft 6in, gross tonnage 3300; 700 passengers, 120 cars; two sets of geared turbines, taking steam from two Babcock and Wilcox boilers, 8000 s.h.p., 20 knots. Launch, December 14th.

HOWARD SMITH, steam tug; built by Hall Russell and Co., Ltd., for Australian Steamships Proprietory, Ltd., Sydney; length between perpendiculars 125ft, breadth moulded 32ft, depth moulded 17ft 3in; triple-expansion, direct-acting steam engine, 1320 i.h.p. at 118 r.p.m., steam supplied at 200 lb per square inch by two coal-burning cylindrical, single-ended boilers. Launch, December 14th.

ROONAGH HEAD, cargo liner; built by Harland and Wolff, Ltd., for the Ulster Steamship Company, Ltd.; length between perpendiculars 430ft, breadth moulded 59ft 3in, depth moulded to shelter deck 39ft 4in, gross tonnage 6200; one set of double reduction geared turbines taking steam from two Babcock and Wilcox water-tube boilers, 5000 s.h.p. Launch, December 17th.

REGENT SPRINGBOK, motor tanker; built by Blythswood Shipbuilding Company, Ltd., for the Bowring Steamship Company, Ltd.; length between perpendiculars 516ft, breadth moulded 70ft 6in, depth moulded 38ft, deadweight 17,600 tons on 30ft draught; thirty cargo oil tanks, two pump rooms, four steam-driven cargo oil pumps 1400 tons per hour capacity, steam deck machinery; Rowan-Doxford two-stroke oil engine, five cylinders 670mm diameter by 2320mm combined stroke, 5600 b.h.p., two single-ended return tube boilers, 14½ knots. Trial, December 19th.

CHAKRATA, cargo liner; built by Swan, Hunter and Wigham Richardson, Ltd., for the British India Steam Navigation Company, Ltd.; length between perpendiculars 455ft, breadth moulded 62ft 6in, depth moulded to shelter deck 40ft 9in, deadweight 9200 tons on 27ft 2½in draught; five cargo holds, sixteen derricks and two heavy derricks, one to lift 30 tons and the other 20 tons, steam deck machinery; Swan Hunter-Doxford oil engine; six cylinders 670mm diameter by 2320mm combined stroke, 6800 b.h.p. at 116 r.p.m., heavy fuel, two cylindrical multi-tubular boilers; service speed 14½ knots. Trial, December 20th.

EASTERN STAR, cargo liner; built by Harland and Wolff, Ltd., for Common Brothers, Ltd.; length between perpendiculars 435ft, breadth moulded 59ft 9in, depth moulded to shelter deck 38ft 6in, gross tonnage 6200; five cargo holds, sixteen derricks and one to lift 50 tons, electric deck machinery; one set of Parsons triple expansion, condensing, double-reduction geared turbines, 7250 s.h.p. at propeller speed of 110 r.p.m.; two Babcock and Wilcox boilers supply steam at 450 lb per square inch and 750 deg. Fah.; four 200kW, 225V, d.c. diesel generators. Trial, December 20th.

WHEATFIELD, oil tanker; built by the Furness Shipbuilding Company, Ltd., for Eden Tankers, Ltd.; length between perpendiculars 496ft, breadth moulded 67ft 6in, depth moulded 36ft 5in, deadweight 16,300 tons; Fairfield-Doxford oil engine, five cylinders 670mm diameter by 2320mm combined stroke, 5500 b.h.p. at 112 r.p.m. Launch, December 29th.